AIR ENGINEERING

APRIL, 1959

AIR POLLUTION CONTROL • AIR MOVING • AIR CONDITIONING

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- *Ventilating An AUTOMATED Factory*
- *Dow Chemical Stops Industrial Odors*
- *Big Building Air System Controlled By "Brain"*

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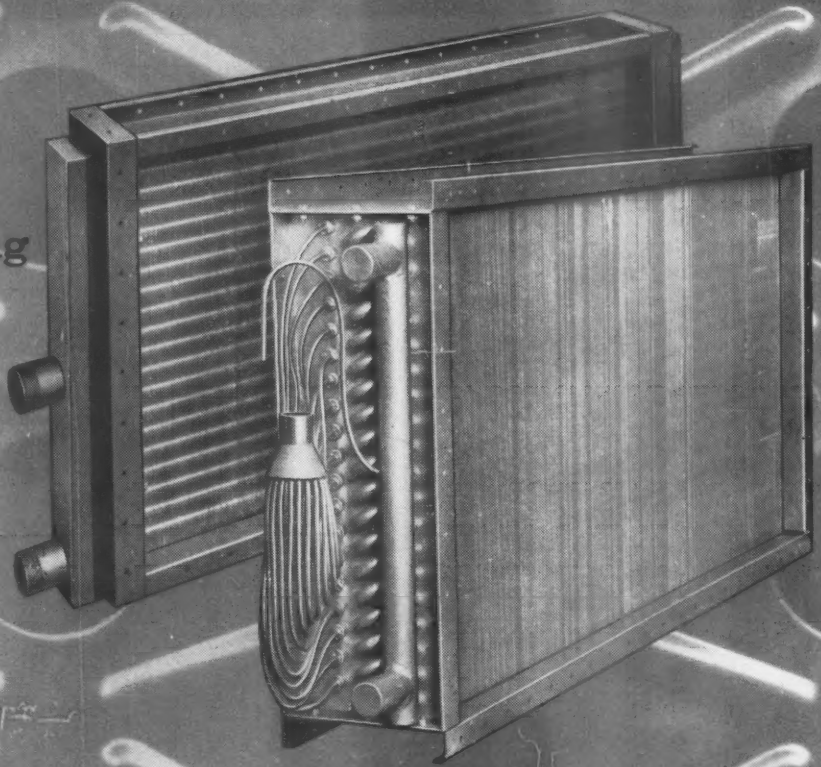

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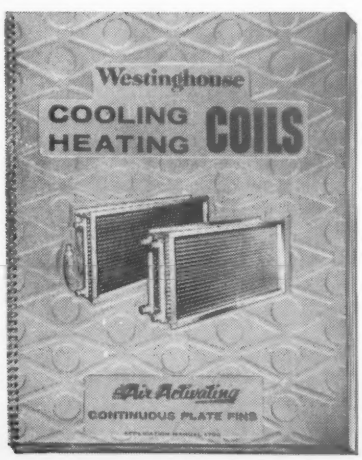

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AIR ENGINEERING

VOL. 1, NO. 1 APRIL, 1959

DEDICATED TO THE SCIENCE OF AIR POLLUTION CONTROL • AIR MOVING • AIR CONDITIONING

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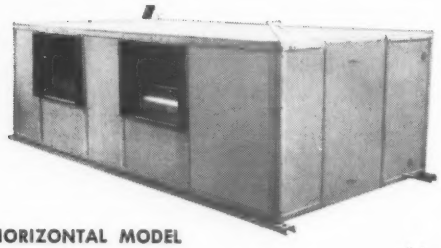

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Letters

Editor:

Best wishes for a successful "launching" of AIR ENGINEERING. The need for a publication of this kind is very real and we will be anxious to see good results. We know you have the publishing know-how.

D. W. Osterholt, President
Scrymiger & Osterholt Advertising, Inc.
Phoenix Building
Minneapolis 1, Minnesota

Editor:

Thank you for a copy of the editorial objectives and policies for AIR ENGINEERING. These shouldn't leave any doubt in an author's mind of your requirements. Thanks also for the January issue of AIR ENGINEERING Newsletter. It is a most interesting publication.

H. C. McDaniel, Director
Technical Information
Westinghouse Electric Corp.
3 Gateway Center, P. O. Box 2278
Pittsburgh 30, Pennsylvania

Editor:

The advance information on your forthcoming publication makes it sound very interesting. We are returning our subscription card today and will look forward to seeing your first issue.

Clinton H. Johnson
VanSant Dugdale and Company, Inc.
15 East Fayette Street
Baltimore 2, Maryland

Editor:

We are pleased to welcome you to membership to the Michigan Industrial Hygiene Society. We believe you will gain much both from the talks given at our meetings and also from the opportunity to chat about industrial hygiene matters with our members.

Inasmuch as our members both contribute as well as gain in connection with this association, we believe that your position as editor of AIR ENGINEERING may bring you in contact with information which will make good subject matter for certain of our talks either before the regular meetings or at the all day meeting which is held in May.

Warren A. Cook, President
Michigan Industrial Hygiene Society

Editor:

Finally, a publication for plant engineers with ventilation problems to solve.

Otto Brechtelsbauer
Ventilation Engineer
Chevrolet Gray Iron Foundry
Saginaw, Michigan

New Akron School Selects Lennox Comfort Curtain

. . . as the finest of all heating-ventilating systems once again comes in at the lowest bid price!

This winter the new Robert Guinther School will have one of the most refreshing and comfortable indoor climates of any school in the entire country. The reason: the specification of the new Lennox Comfort Curtain heating-ventilating system.

This all-new system applies to classrooms the sound, tested principles of perimeter air distribution, with the rapid, accurate responses to temperature changes which only an all air system can give. In comfort, in flexibility, in economy of installation and operation—it outperforms all other systems. Read the facts below. Then send in the coupon for free booklet.

NEW LENNOX COMFORT CURTAIN SYSTEM OFFERS THESE IMPORTANT AND FAR-REACHING ADVANTAGES

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Lower building costs—No expensive pipe tunnels. Installation time and expense reduced with completely assembled units.

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Above: View of a portion of 100-plus Aerovent "Model 53" Roof Ventilators installed on a West Coast auto assembly plant. Below: Closeup of a single Model 53 "low-level" unit. Standard and special-purpose units available in sizes 12" to 72" for capacities to 93,500 CFM. 3 types.

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Letters

Editor:

The Newsletter relative to your new paper, AIR ENGINEERING, is most welcome. I believe there is a real need for comprehensive coverage in this field. Various phases of this problem are covered in a number of publications, many of which are not seen by people to whom the development would be of interest or are seen only after a delay of years.

Your use of the word "crusade" is justified if, in editorial policy, you hold strictly to the scientific approach in both headlines and stories and that "opinion" be clearly labeled as such.

In view of the scare tactics on health so widely employed in TV and other advertising, I recognize the difficulty in holding true scientific integrity and I appreciate that the truth is often not nearly as good reading or promotion as someone's fancy. Nevertheless the usefulness of your Journal, and I think in the long run its success, will depend on the accuracy of your reporting.

Charles S. Leopold, Engineer
215 South Broad Street
Philadelphia 7, Pennsylvania

Editor:

Secretary Fleming was happy to receive your letter of February 16, 1959, regarding your new publication AIR ENGINEERING. He has referred your letter to me, as this office has the responsibility for matters relating to the engineering and physical sciences aspects of the Public Health Service Air Pollution Program.

We have entered a subscription for AIR ENGINEERING and look forward to receiving the first issue in April.

Frank Tetzlaff, Chief
Air Pollution Engineering Program
Division of Sanitary Engineering Services
Department of Health, Education, and Welfare
Washington 25, D. C.

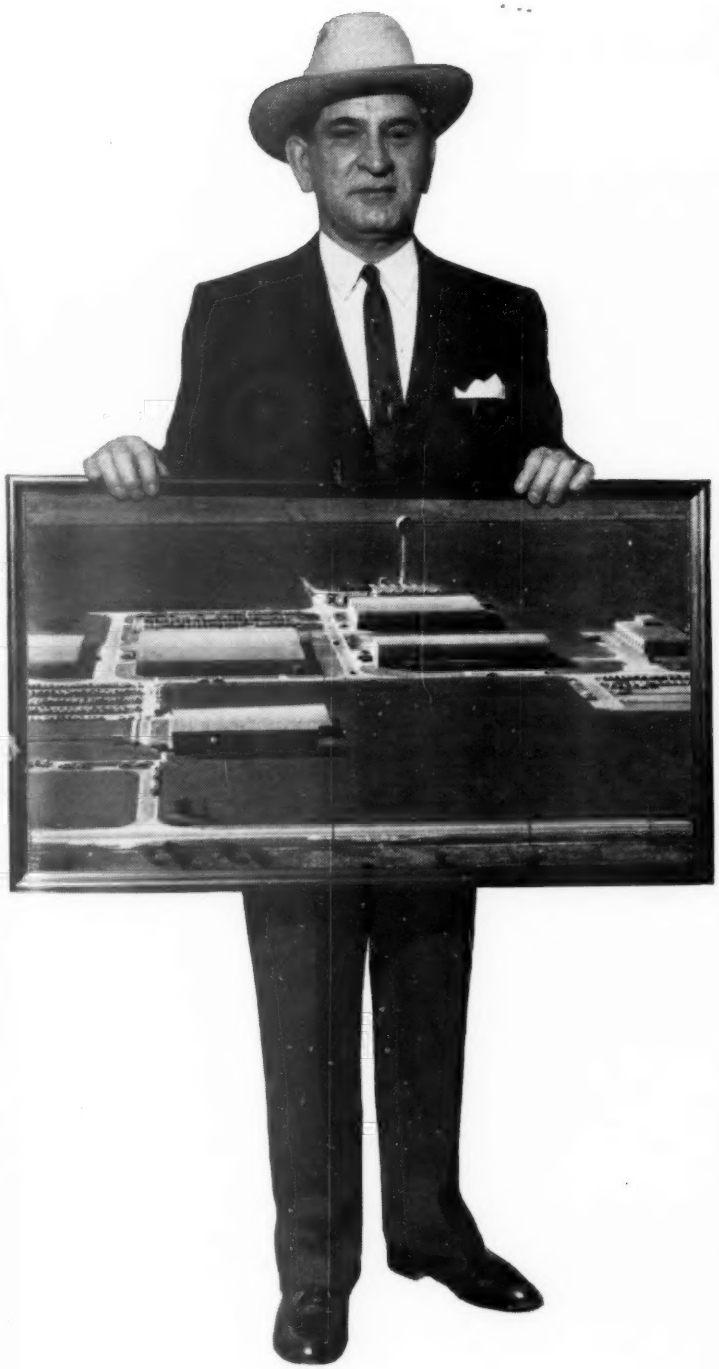
Editor:

I have your Vol. 1, No. 1 Newsletter in which you mentioned that you were coming out with a new magazine in April, called AIR ENGINEERING. I am requesting our Library to subscribe for this new magazine.

I have just received a complaint from one of our retread shops about bad odors. Do you know of any company that might provide some "perfume" to be added to the air to make it smell better or possibly a washer that would launder the bad odors from the air?

Hoping that your new magazine is a great success.

Engineering Dept.
Large Manufacturer



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"We'd need 2,400 *tons* of ice—every day—to cool the eight buildings in Dresser Electronics Center*. It takes just *four* Chrysler Centrifugal Units to do the job. And, with Climate by Chrysler, we get many other important benefits, besides.

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Whether your air conditioning requirement is 30 tons, or 3,000—it will pay you to get the Chrysler story. Contact your local Chrysler Applied Machinery and Systems sales office. Or write: Airtemp Division, Chrysler Corporation, Dept. AA-49, Dayton 1, Ohio.

*New Houston, Texas home of Southwestern Industrial Electronics Co., a Division of Dresser Industries. Shown above: E. L. Andrews, Facility Director for Dresser Industries, Inc. *Architects:* Pierce & Pierce. *Consultants:* Bernard Johnson & Associates; Weldon W. Henderson, Consulting Engineer.

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BULLETIN G-579 — Describes the DAY Type "RJ" filter. An all purpose, versatile unit. Bulletin gives operating features, dimensions and specifications.

BULLETIN 573 — Dual-Clone dust separators — noted for their low resistance and high cleaning efficiency. Easy to install, no maintenance, no moving parts.

BULLETIN 576 — "HV" heavy duty dust separator. Rugged construction and lower initial cost than many light gauge galvanized type cyclones.

BULLETIN F-75 — Reverse Jet Dust Filter Facts. Complete with specifications, typical equipment layouts, capacity and performance tables for DAY type "AC" filter.

BULLETIN N-578 — Gives complete information about Style "A" rotary valves. Construction features, specifications, dimensions and applications.

"SCHLITZ DEFEATS DUST" — FOOD ENGINEERING magazine reprint describes all out dust control for 3½ million bushel Schlitz grain elevator. Request Bulletin "Schlitz Defeats Dust."

"EFFICIENT DUST SNATCHERS" — Bulletin describes DAY's part in providing maximum safety and good housekeeping for starch packing building of large food processor.

BULLETIN 510 — DAY Unit Dust Collectors. Complete, low cost unit designed for plants or applications where central dust control systems are not practical.

BULLETIN I-585 — Industrial Fans. Complete with helpful selection charts, capacity tables, dimensions and specifications. Information on special types and arrangements included.

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Letters

Editor:

We wish to thank you for your circular regarding your new magazine AIR ENGINEERING, due for publication in April 1959. We are very interested in this project and we will be pleased if you could arrange to forward a sample copy of this magazine when published.

K. Thompson
Thermix Industries Limited
Thermix House,
Surbiton Crescent
Kingston-Upon-Thames
Surrey, England

Editor:

Please send me an advance copy as soon as the new baby is off the press. And the very best to you in this interesting venture.

Leslie M. Beals
Director of Advertising
and Sales Promotion
Carrier Corporation
Syracuse 1, New York

Editor:

I would like to say that we were pleased to have you as our guest at the recent Industrial Ventilation Conference and I hope that you will reap a fine harvest of technical articles and authors for AIR ENGINEERING. If I can be of any further assistance, please do not hesitate to get in touch with me.

James C. Barrett
Ventilation Engineer
Div. of Occupational Health
Michigan Dept. of Health
Lansing 4, Michigan

COVER

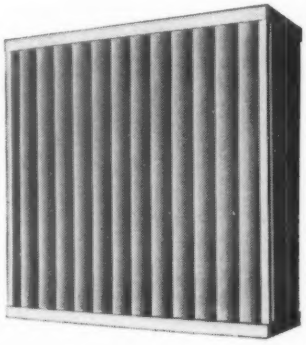
Are engineers interested in abstractions, four-color process, magazine covers? Maybe yes, maybe no, but what a dreary world this would be without color.

Since we believe a business or engineering publication can be attractive *and* useful, and since the essence of anything is often in the way it's served to you, our plan is to produce AIR ENGINEERING in a way that will make you proud to subscribe, and you'll receive benefit through reading it.

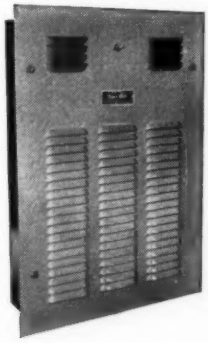
So our first cover is an exclusive process abstraction developed by our own art director, William A. Bostick. Title: Mill Town. Symbolizes industrial air problems. That's what AIR ENGINEERING is all about.

Activated charcoal purification equipment

Barnebey-Cheney manufactures activated charcoal and purification equipment for air, water and chemical products. Used in air purification, AC saves on heating-cooling costs by permitting recirculation of air. AC adsorbs odors, irritating vapors, smoke and smog. Completely revitalizes stale or stuffy air.



FilterFold adsorbers Pleated filter with ½ in. bed of charcoal. Installed in multiples, these cells give large air handling capacity in a small space. Each cell will handle up to 1,000 cfm at 0.2 wg. Heavy guage steel frames take rough treatment (stainless frames available). Five types available.

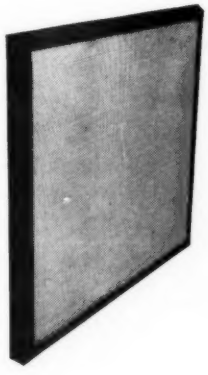


Wall unit Flush mounted circulator for semi-light duty use. Contains centrifugal fan, charcoal filter, and dust filter. Steel cover plate furnished with prime coat. Designed to fit between studding. Capacity: 150 cfm.

Cabinet circulators Complete units contain panel adsorbers, dust filter, centrifugal blower, and motor assembly. They are fully assembled, ready to plug in. Designed for long service and quiet operation 24 hours a day. They will purify up to 12,000 cubic feet of space.

Heavy duty units are available for warehouse or industrial operation. These may be ceiling mounted or portable.

Canister circulators Complete unit contains removable canister and blower-motor assembly. Designed for small rooms and enclosed areas. Four models, with capacities from 15 to 120 cfm. Either floor stands or wall mounting available.



Panel adsorbers Flat perforated metal cell with 1 in. bed of activated charcoal. Use it when the contaminant load is heavy and you want long service life. Frame assemblies and panels are available for any air flow. Capacities up to 180 cfm at 0.3 wg. Three models.

Canister adsorbers Cylindrical perforated metal with ⅝ in. to ¾ in. bed of charcoal. Use these for small jobs and for expansion of existing installations. They are mounted in manifold plates in multiples, depending on cfm, and are interchangeable with other types of canisters. Four models.

Other products and services Disposable charcoal filters in paperboard frames are available for use in air conditioners, forced air furnaces, and ventilating systems. Breeze circulators are attractive units for homes, offices, clubs.

Barnebey-Cheney's complete line of activated charcoals is available in bulk.

Ask for free literature.

Cassady at Eighth, Columbus 19, Ohio

Los Angeles • San Antonio • St. Johns, Quebec

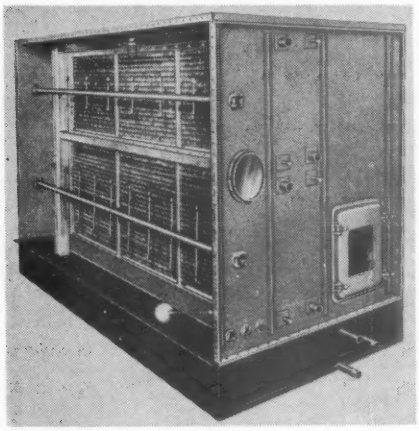
Barnebey Cheney

New PRODUCTS

Sprayed Coil Dehumidifier

Line of low and high pressure blow-through sprayed coil dehumidifiers that meet requirements for medium and high velocity all-air systems in multi-story buildings has been added by American-Standard.

Both low and high pressure units are available in 127 sizes with capacities from 2,310 to 45,900 cfm and for operation to 9 in. w.g. static pressure.

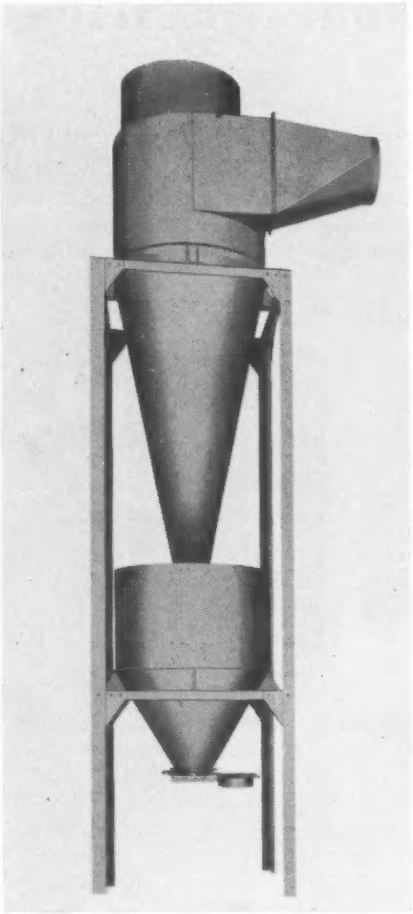


Casing is both air and water tight when used in single zone, multizone, or dual duct blow-through systems. Units are available with either direct expansion Type X coils or chilled water Type W coils. Both ends of coils are sealed inside casing to eliminate sweating and dripping. Coil units are removable for service.

Separate section fastened to air entering end of dehumidifier contains inlet louvers having removable blades. Louvers prevent spray from backlashing when dual duct or multizone system air passes through bypass duct or hot deck above sprayed coil dehumidifier.

Source: *American-Standard Industrial Division, Dept. AE, Detroit 32, Mich.*

Use Communications Center, page 65, for requesting more information about articles, advertised products, literature, and for comments about any of the editorial material in this issue of AIR ENGINEERING.



High Efficiency Cyclone

New cyclone separator which operates in the 4,000 to 6,000-plus cfm range is introduced by Torit Mfg. Co. Model 36 features adjustable belt drive to give wide range of cfm performances against varying resistances. In laboratory tests it has separated 99.2 percent of steel grindings, 99 percent of sawdust, and 94 percent of flour by weight.

Blower is mounted either on clean air side of collector or remotely to prevent fan damage. Model 36 is designed for outdoor exhaust.

It has 14 in. inlets and outlets. Standard base has 30 cu. ft. storage capacity for dust, emptied through airtight slide gate. Separator occupies 44 by 70½ in. floor space and measures 13 ft. 9⅜ in. from hopper outlet to top.

Source: *Torit Mfg. Co., Dept. KP-AE, Walnut & Exchange Sts., St. Paul, Minn.*

Btu Meter for Water Systems

Low priced mechanical Btu meter that accounts for refrigeration and heating furnished by central air conditioning systems using hot or chilled water has been developed by American Meter Co.

Model 200 multiplies temperature change of water by flow and two counters register the heat transferred and the water flow. Indication of differential temperature is provided.

Btu meter can be located up to 10 ft. from flow measuring element. Any water volume over .25 gpm can be metered.

Source: *American Meter Co., Mechanical Components Dept., Dept. AE, P. O. Box 306, Garland, Texas.*

Flexible Duct Connector

Newly designed flexible duct connector to reduce shop fabrication time and improve appearance of completed connector is introduced by Duro-Dyne Corp.

Griploc, a new method of fastening fabric to metal, consists of a continuous series of fingers which grip fabric by means of a double lock. It dispenses flat, cuts with ordinary snips, and forms on brake without tearing fabric.

Source: *Dept. AE, Duro-Dyne Corp., Farmingdale, N. Y.*

(Please turn to page 76)

Chicago's City Council has given approval to a new air pollution control ordinance extending jurisdiction of control officials to all sources of air pollution. Formerly, the jurisdiction of air pollution control officials covered only emissions from combustion sources (fuel burning).

New ordinance provides a grace period clause, ranging from 5 to 10 years, which permits industries such as the South Chicago steel plants to comply. It is estimated that eventually many millions of dollars will be expended for such equipment as precipitators over open hearth furnaces and sintering plants.

It has been indicated that the new ordinance will not bring forth any hasty and dramatic "clean-up" attempts, but will permit increasing pressure to be applied to improve the atmosphere in the Chicago area.

* * *

Scope of The Electronic Air Cleaner Standardization Committee of the Air Filter Institute has been broadened to include the development of a standardized test procedure which, when adopted, will become a section of the Air Filter Institute Code for Testing Air Cleaning Devices Used in General Ventilation. The first section of this Code covering unit or panel-type filters was adopted in 1953.

The committee is also working on the standardization of terminology in the electronic air cleaner field.

* * *

Some effort may be made soon to obtain a change in Underwriters' Laboratories standards for panel-type air filters, many in the air filter industry believing that present standards are unrealistic.

Principal point of contention is that present standards are based upon the testing of a brand new filter in an unused, clean condition. The argument made by those in the industry is that filters in actual use are practically never clean and so measurements on filter efficiency for establishing standards should be made in something other than clean condition. There is a feeling that under the present standard, a filter which fails to meet the standard may be no worse than an accepted model if they were both tested in a condition which would simulate normal usage.

* * *

A bill which would have prohibited the selling of cars without anti-smog devices in Los Angeles has been rejected by an 8-to-1 vote by a California Legislative Assembly committee.

Proponents of the bill said it would be "a club to force auto makers to get busy on research" but admitted there is no device presently available which is more than 50 percent effective.

* * *

A state-wide survey of air pollution in Pennsylvania will be undertaken in the near future, reports Dr. Charles L. Wilbar, Jr., Pennsylvania State Secretary of Health.

Conditions in every community of more than 2,500 population will be studied under the direction of Dr. David M. Anderson, U. S. Public Health Service engineer.

Red dust from a Trenton. N. J. plant stirred up area residents and, in turn, a city official.

A man who said he was speaking for a majority of the neighbors showed Public Affairs Director Arthur J. Holland and City Sanitarian Theodore Scheidt his car, covered with a red-dust film. The dust also reportedly seeps into nearby homes.

Later, Holland asserted that the dust was creating a "real health hazard." He instructed Scheidt to tell company officials "they must comply with the law or the city will bring action to close them down."

Because the dust does not come from a smokestack, it probably is not a technical violation of the state anti-air pollution law, Scheidt stated. But Holland thought such a condition could be controlled under the general police power of municipalities to protect the health of residents.

Under a city anti-air pollution ordinance that was being drafted by Scheidt, spreading of such dust would be banned even if it doesn't come from smoke stacks, according to Holland. The dust, presumably composed of "oxides," is emitted from a ventilator and open windows, Scheidt explained. He added that company officials had agreed to correct the situation but had not acted yet.

* * *

Now underway for the surgeries of Los Angeles' Mt. Sinai hospital is the installation of what is termed a "revolutionary" aseptic-air system, functioning in conjunction with air conditioning systems, which its developers say will kill in excess of 99.9 percent of air-borne bacteria.

The system design, developed by Reginald Robbins, Los Angeles medical researcher, and Prof. Gennady W. Potapenko of California Institute of Technology, has two special design features to insure the effective radiation of the free air. One is a cylindrical aluminum chamber whose inner surface is highly reflective for radiation in the germicidal ultraviolet range. Inside the chamber is a baffle which induces turbulence and directs the air in a cyclonic pattern that insures complete exposure.

* * *

"Fresh air is good medicine and good business." So said Michigan Health Commissioner Dr. Albert E. Huestis at an Industrial Ventilation Conference at Michigan State University.

The State Health Department recently induced a manufacturer of plastic dishes to install an $8,000 ventilation system, he related. The system not only protects the workers from inhaling irritating plastic dusts but nets the firm as much as $5,000 a month by reducing the number of dust-specked dishes which have to be scrapped, according to Dr. Huestis.

* * *

A six-point "broad scope" anti-smog program has been proposed by Gov. Edmund G. Brown of California for passage by the state legislature.

The program calls for:

1. Establishment of state standards in air pollution.
2. Determination of the amount of pollution in automobile exhausts.
3. Establishment of an Air Pollution District in the San Joaquin Valley.
4. The establishment of a research center in Los Angeles.
5. A $100,000 contract with an independent agency to study air pollution.
6. Application of the full prestige and pressure of the state on the Federal government for aid in the fight against smog.

AIR ENGINEERING

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EDITORIAL:

New TOTAL Concept of Air Engineering With Regard to Human Health

SELF-PRESERVATION is the First Law of Nature. Moreover, it is the prime motive behind most current scientific research. Our subsequent material progress, in this exciting age of mankind, really stems from that primal human instinct.

Those who decry our so-called "materialistic civilization" overlook the fact that present industrial activity is involved hugely with protecting and prolonging human life. And life itself is the supreme gift of our Creator. So who can say that the act of extending life doesn't have spiritual values?

"*Protecting and prolonging life*" embraces three major phases of scientific and business enterprise:

1. *Preventing mass annihilation* by developing super-weapons which make warfare uneconomic, unfeasible, and insane.
2. *Enhancing life and its joys* through labor-saving devices for factory, office, and home.
3. *Prolonging life* by protecting it against hostile environmental forces—from microbes and smog to debilitating temperatures.

The United States of America has done mighty well in the first two categories. Our weaponry (although under political fire from time to time) has deterred World War III. And our labor-saving devices, from plant automation to Mama's push-button kitchen, are the envy of the entire civilized world.

However, we've lagged behind Europe in preventive medical research and its applications. Our ratio of heart attacks, cancer, and respiratory diseases rank at or near the top (which means the worst) among nations of the world.

Thus we Americans, who have the greatest facilities and capacities for enjoying life to the utmost, aren't doing enough to extend it. Too many of us die too young. One doesn't have to be an alarmist to recognize the validity of comparative statistics on this point.

For example: Dr. A. J. Haagen-Smit, of the California Institute of Technology, has asserted recently that unless stringent methods are instituted, many American cities will become such potential death traps as Donora, Pa., and the Meuse Valley in Belgium—where bad air has caused suffocations.

Although the auto industry, for one, is engaged in a major effort to minimize exhaust fumes, Dr. Haagen-Smit observes that such equipment is unlikely to be generally applicable before 1965. By then, its

(Please turn to following page)

NEWS of the Industry

From the Field of Medicine and Health

Medical research has clearly demonstrated that many of the components of urban air can cause serious illness when breathed in concentrations higher than those normally found in the atmosphere, Dr. L. E. Burney, surgeon general of the Public Health Service, U. S. Dept. of Health, Education, and Welfare, warned recently.

Addressing the Society of Automotive Engineers in March, Dr. Burney reminded them that certain components of automobile exhaust are known as cancer causing substances.

"Recent field studies have shown a statistical relationship between high levels of air pollution and high death rates due to heart disease, cancer of the lung, stomach, and esophagus," he said. "In its acute form, air pollution has shown itself capable both here and abroad of directly causing deaths and serious illness."

"In short, the nation has come up against the fact that it is robbing itself of safe and healthful air to breathe."

Dr. Burney commented that the $1 million each the automotive and petroleum industries are spending annually on air pollution research programs was far short of what should be expected of them.

"Automotive engineers have played a very important part in improving engine and exhaust systems," he said. "It is true that today when a car is properly tuned and warmed up, nothing visible comes from its tailpipe.

"But many of the most toxic pollutants in contemporary air pollution are not visible. Moreover, improvements you have made are rapidly being overcome by tremendous increases in the size of engines and number of cars.

"Every thousand operating automobiles in a community emit daily approximately 3.2 tons of carbon monoxide, and hundreds of pounds of other pollutants which are even more essential to the formation of smog."

Dr. Burney did not agree with those who contend that automobile exhaust is only a problem in Los Angeles. It is responsible for much eye irritation and horticultural damage in other metropolitan areas, he asserted.

In Los Angeles, the Air Pollution Foundation, in its fifth annual report, announced that it found key pollutants in the city's smog-ridden atmosphere to be nitrogen oxides and hydrocarbons. Highest concentrations of both are found in automobile exhaust.

Approximately 80 percent of the total hydrocarbons and 95 percent of the olefins in the Los Angeles atmosphere come from automobile exhaust, the Foundation said.

W. L. Faith, managing director, estimated that two more years of work will complete the basic research phase of the Los Angeles smog problem. It will provide all essential facts so that private industry can take over from that point and produce workable, economic controls.

Report on Man-Hour Loss From Respiratory Disease

U. S. Dept. of Health, Education, and Welfare is also interested in another air pollution problem, the control of radiation monitoring. Secretary Arthur S. Flemming on March 17 announced an increase in research into the safe limit of strontium 90 in food and water.

Problems of radiation "will be with us from now on. They can-

Editorial (Cont.)

New Total Concept of Air Engineering With Regard To Human Health

prospective 50 percent reduction in the two major smog constituents, hydrocarbons and nitrogen oxide, will no more than offset the intervening increase in automobiles and population, both of which are growing at a rate of 5 percent or more each year.

"The task of protecting life by controlling air is not an easy one," he adds. "We need more and larger breathing spaces, and a complete revision of our thinking as to public transportation, manufacturing, and the buildings we inhabit."

What's at stake is public health . . . Life itself. America's founding philosophy ("Life, liberty, and the pursuit of happiness") is noble, indeed. Without Life, though, liberty and the pursuit of happiness are long gone.

The more we learn about prolonging human existence, the more we realize that temperature control affects health almost as much as does *air cleanliness*. Neither have had the emphasis they deserve in terms of implementing the INSTINCT FOR SELF-PRESERVATION.

Interesting thing about all this is that adequately filtered air conditioning inside buildings, homes, and automobiles is a major answer to this newly-stated health concept.

Time may come—and sooner than many might guess—when air conditioned factories, offices, automobiles, etc.—will be almost a necessity for survival. Even now, it has economic justification in terms of employee efficiency and factory housekeeping.

Thus it is that we submit this first issue of AIR ENGINEERING to you with a sense of dedication and destiny. It embraces a new concept—that AIR must be treated as an *entity*. It weds air conditioning to air pollution control. They are inseparable in terms of longer living.

Pure air is getting scarce, and will get more so, rapidly. We'd better start saving it. Temperature air control has a kinship, too, in terms of health - life - happiness. Whatever any of us can do to sift the problems entailed, find solutions, and put them into effect, will help all of us to preserve, protect, and prolong Life itself. AIR ENGINEERING, which will attempt to do that for everyone, obviously is a Magazine with a Mission.

The brand new TOTAL concept of air conditioning can mean money, recognition, and a worthy contribution to future generations for those grasping its signficance.

not, and should not, be minimized," he said.

A health survey conducted by the U. S. department last year, covering the period from July, 1957 to June, 1958, indicated that acute respiratory conditions accounted for about 1,172 million man-days of restricted activity, 593 million man-days of bed disability, 291 million man-days lost from work, and 196 million man-days lost from school.

H-E-W admitted that these figures were distended somewhat by an epidemic of Asiatic flu in the latter part of 1957. However, it was clearly shown that time lost through acute respiratory conditions was far greater than from infections and parasitic conditions, digestive conditions, or injuries.

Some English Activity On Air Pollution Front

Since 4,000 Londoners died in the smog of December, 1952, a team of 12 physicians, physicists, and chemists at London's St. Bartholomew's Hospital have taken air samplings every hour or half-hour day and night during every period of winter fog, the medical newspaper Scope Weekly reports.

They found concentration of air pollutants, already very high in an ordinary period of smog, may take an inordinate and sudden rise.

Dr. P. J. Lawther, head of the team, speculates that "a reasonable, simple hypothesis is that the highly irritant atmosphere kills those who cannot tolerate extra strain on their cardiovascular and respiratory systems."

Britain in 1956 adopted a Clean Air Act through which it hopes to eliminate 80 percent of black smoke in populated centers by 1970.

This is a formidable task in a country where most factories and homes burn soft coal. Tax relief is being offered to plants who improve fuel efficiency, convert to coke, gas, or electricity, eliminate grit and dust, and wash sulfur dioxide from flue gases.

Homeowners in some 200 smoke control areas are reimbursed 70 percent of the cost of new, more efficient heating appliances.

The Auto Exhaust Situation

Future of automobile exhaust smog control could possibly be decided in the tests which California air pollution control authorities will conduct on exhaust emission control devices which the Automobile Manufacturers Association has shipped to them.

There has been some indication that the automobile manufacturers will rely upon the test results for the direction in which they may move to provide an exhaust control for standard passenger automobiles. Principal testing will probably be conducted by the Los Angeles Air Pollution Control District, although units are being sent to the Bay Area (San Francisco) and to the California State Public Health Department at San Francisco.

All of the units shipped thus far are the low-temperature catalytic converter developed primarily by the Ford Motor Co. These use vanadium pentoxide as a catalyst, and reportedly attain 60 to 73 percent efficiency in removal of hydrocarbons.

At a later date shipments will be made, to the same test sources, of a catalytic converter, on which General Motors Corp. is doing development work in cooperation with Oxy-Catalyst, Inc., of Wayne, Pa., which has produced workable internal combustion truck exhaust emission control units. If a flame-type afterburner proves it has exhaust control possibilities, it too will be sent to California for testing.

Technicians and mechanics will be supplied by the Automobile Manufacturers Association to assist in the test operations, to assure proper mountings of the devices on stock models of automobiles, and to provide all help possible in getting a meaningful test program.

Earlier this year, in a presentation before the California Legislature, representatives of the automobile industry outlined a proposed three-point program for the reduction of exhaust gas emissions:

1. Establishment of an inspection procedure under official jurisdiction so that all the cars in the Los Angeles area could be regularly inspected for their hydrocarbon emission.

2. Development of a program to have all existing vehicles in the Los Angeles area put into proper mechanical condition, for the reason that adequate technical evidence has been developed to show that such a procedure can result in some important reductions in the emission levels.

3. Installation of exhaust control devices.

The legislature was told that in the present state of development, passenger car exhaust control devices might cost around $150. A spokesman for the group of automobile engineering executives who appeared before the legislature stated the industry's position in the following statement:

"In Detroit in January our engineers reported that we had made a technical breakthrough and that now we can see our way toward having exhaust gas emission control devices. They are like new cars in the development stage. They are working, but they need a lot of improvement before they can be available for use.

"However, if these devices plus perfect maintenance could eliminate all hydrocarbons from exhaust gas, there is no sure proof that they would be the complete answer to the Los Angeles smog situation."

'Cleaner Gasoline' Gets Into the Act in Calif.

Hottest item in the Los Angeles smog control situation at the present time is the subject of so-called "cleaner gasolines."

Tidewater Oil Co. got the subject into the spotlight when it announced claims that it had developed a gasoline that had a lower vapor pressure and was "cleaner" gasoline and would thus reduce the smog effect of automobile exhaust.

Tests conducted by the Los Angeles County Air Pollution Control District showed that while the vapor pressure was relatively low, that it was the low olefinic content of the company's top grade gasoline which proved most interesting—and of most likely benefit. Later Standard Oil Co. of California submitted its top-grade gasoline, which showed an even lower olefinic content.

When the Air Pollution Control officers reported their findings to the Los Angeles County Board of Supervisors, and pointed out that the amount of olefins in gasoline is responsible for the eye irritating effect in smog, and that the gasolines tested had an olefinic content rating of 12½ to 15 percent,

(Please turn to following page)

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NEWS of the Industry...

(Continued from preceding page)

whereas the general range for all gasolines might go from 15 to 40 percent, the supervisors saw a new approach for some relief to the smog problem.

They passed a resolution which would have the Air Pollution Control offices test various makes of gasoline every month, and report on these tests. It was also recommended in the resolution that some sort of merit award be given every month to the gasoline that was found to be the "cleanest" (probably meaning from the standpoint of olefinic content).

When Tidewater first made its comments about developing a gasoline that was "cleaner" it drew criticism from other oil companies —principally General Petroleum Corp. and Richfield Oil Co.—to the effect that raising gasoline vapor pressure in the winter and lowering it in the summer is a common industry practice.

In reply, Herschel Y. Hyde, vice president and director for Tidewater, expressed himself as "shocked" and "dismayed" at such criticism, declaring:

"When we say you can cut evaporation 50 percent by lowering vapor pressure an average of two pounds—winter and summer—we stand on solid ground."

Air Pollution Agency Activity

NEW YORK CITY: Department of Air Pollution Control, in its Budget Request for the 1959-1960 fiscal year, asks for $691,235, up about $22,000 from the current appropriation. Increases include $18,495 in salary increments made mandatory by law and $3,595 for items other than personal services.

* * *

BROOKLYN: A Supreme Court referee upheld a new municipal law banning open burning of scrapped auto bodies or any parts thereof. This was the second time auto wreckers tried to have the law declared unconstitutional.

* * *

LOS ANGELES: Recently-published report based on a 30-month survey and entitled "Emissions to the Atmosphere from Petroleum Refineries in Los Angeles County" is available at $3 a copy from Air Pollution Control District, County of Los Angeles, 434 S. San Pedro St., Los Angeles 13, Calif.

* * *

NEW YORK STATE: Study of air pollution problems in Erie county was launched by the State Board of Air Pollution Control. It'll be the first quantitative estimate of air pollution in the state. Other areas marked for study: Niagara Frontier, New York City, Capital District, Syracuse, Mohawk Valley, Southern Tier, Rochester, Northern Area, and Mid-Hudson.... Edward J. Kilcawley, professor and head of the division of soil mechanics and sanitary engineering at Rensselaer Polytechnic Institute, was nominated by Gov. Rockefeller as a member of the air pollution control board.

* * *

CLEVELAND — Cleveland city councilmen have demanded more money be budgeted to fight air pollution, a newspaper report of a council meeting stating that "in tones more demanding than any they have used so far in their review of the financial program for 1959, they asked for a 24-hour search for smoke violators."

One member of the council asked that an additional $53,000 be spent to hire more smoke inspectors, and another asked for $100,000. But Urban Renewal Director James Lister, head of the anti-smoke forces, urged a hold-the-line policy on spending, saying:

"We don't need any more inspectors. When the new anti-pollution section of the code is ready, we'll be able to function with those we have now."

Utility Air Conditioning Meeting Draws Plant Men

Effects of air conditioning on industrial processing and employe health were discussed at a meeting March 18 at the handsome new Cleveland Engineering & Scientific Center. Sponsored by the Cleveland Electric Illuminating Co., the event attracted factory managers and plant maintenance engineers from the northern Ohio industrial area.

Speaker George F. Taubeneck of AIR ENGINEERING dwelt on the fact that air conditioning has many more dimensions than mere cool comfort, including the new dimension of health protection through air purification.

The Public Press Views the Industry

Because the news affects public opinion, and public opinion affects what is done about air pollution, AIR ENGINEERING presents a roundup of what the press across the nation has been reporting on this subject.

Staten Island (N.Y.) *Advance:* The seventh annual symposium on air pollution and its control will be held April 25 at Wagner college. Meeting will hear reports by Staten Island industrial establishments on advances made toward insuring clean air for the borough.

The Oregonian: "Portland is suffering from a critical case of smog gas, sometimes far exceeding allowable state standards, according to a report by State Air Pollution Authority." "'The origin of air pollution in Portland is estimated to be 50 percent from industrial sources and 50 percent from commercial and public sources,' the authority stated."

The Cincinnati Post & Times-Star: Six Hamilton county (Ohio) mayors, in a joint letter, asked mayors of eight neighboring communities to join Cincinnati's Metropolitan Air Pollution Control program. Said the letter, in part: "Our program cannot accomplish its ultimate aim until we can present a united front of all valley communities."

The New York Times: A full-page article in the *Times'* (Sunday) Magazine on air pollution touched on smoke, fog, auto exhaust, health (cancer), industry, and the part each plays.

The New York Herald-Tribune: A headline said "Manhattan's Fall (of soot) Exceeds That of a Year Ago." But in the story under the headline, Dr. Leonard Greenburg, commissioner of the city's Department of Air Pollution Control, was quoted as saying that on the whole, "New Yorkers breathed cleaner air in 1958 than in 1957."

Daily News (New York): A full-page article in the front section of the paper pictured the city as fighting a tough but losing battle against air pollution. Fingered were industry and power plants, building heating systems, incinerators, and the 1½ million autos using city streets.

Industrial Marketing: A roundup report on the pollution "headache" noted, among other things: that makers of anti-pollution devices are hard-pressed to meet industry's current needs for new equipment; that industry is spending sizeable amounts of money in efforts to cope with the problem; that better technology is expected to ease the "headache" of polluted air in our cities in the future.

News In General in the Air Handling Field

In other developments so far this year:

Oil Heat Institute has taken an important step toward adoption of a universal code governing the installation of oil burners anywhere. It has published a safety and performance standard for installation of residential boiler and furnace units and for installation of conversion oil burners.

Air-Conditioning & Refrigeration Institute has launched a unitary air conditioner certification program centering on Btu ratings determined according to ARI standards. Forty-two manufacturers currently subscribe to the program which covers all unitary equipment up to 135,000 Btu capacity. National Warm Air Heating & Air Conditioning Association is cooperating in the program.

Lennox Industries, Inc. and American Air Filter Co. have instituted a research program to determine how damaging are the contaminants—if any—left in air after it has passed through electrostatic filters.

New York Association of Consulting Engineers is continuing its battle to get the city of New York to adopt the same fee formula for engineering construction that applies in private practice—2½ times net time card costs of the design staff.

Marley Co., old-line manufacturer of cooling towers, has entered the air-cooled condenser field with a nine-model line ranging from 15 to 100 tons' capacity.

York Corp. has refined its Hi-I high induction heating and cooling system to a 3-pipe system that can heat and cool at the same time. Carrier Corp. has introduced high velocity room terminals for all-air systems. Typhoon Heat Pump Co. claims its new 75-ton water-to-water heat pump is the first factory package heat pump to produce 1 million Btu of heat. Water chilling equipment of several manufacturers has been sharply reduced in size.

Pittsburgh Agreement on Temporary Heat between plumbing contractors and the United Association (AFL-CIO) in effect since 1924, has been revised to cover union jurisdiction over temporary cooling as well as heating in projects under construction.

College Power Plant To Install Precipitator

The University of Washington will install a Cottrell opzel plate-type electrostatic precipitator for fly ash collection during alterations and additions to its central heating and power plant on the Seattle campus. Capacity of the precipitator will be 50,000 cfm of gas with 380 F with rated efficiency of 90 percent, according to Research-Cottrell, Inc.

This precipitator will collect fly ash from a pulverized coal-fired boiler, following a mechanical collector. The installation will include MI (magnetic impulse) rappers to be installed on both the collecting and the discharge electrodes. MI rappers eliminate rapping puffs and stack clouding, it is stated. The electrical equipment includes silicon rectifiers. Bouillon, Griffith & Christofferson, Seattle, are the engineers.

Meetings

American Chemical Society, *Statler Hilton, Boston, April 5-10.*

Research-Cottrell, Inc. Seminar in Industrial Gas Cleaning and Air Pollution Control, *Engineers Club, New York, April 22.*

American Conference of Governmental Industrial Hygienists annual meeting, *Hotel Sherman, Chicago, April 25-28.*

Industrial Waste Conference, *Purdue University, Lafayette, Ind., May 5-7.*

Pennsylvania State University Electrical Precipitation Seminar, *University Park, Pa., June 14-19.*

Air Pollution Control Association annual meeting, *Statler, Los Angeles, June 21-26.*

American Society of Heating, Refrigerating, and Air Conditioning Engineers, *Lake Placid, N. Y., June 22-24.*

Please turn to page 73 for more Industry News.

Building With A Brain

Year-'round air conditioning system in this 500,000 sq. ft. bank building is controlled by unique remote console with high frequency impulse over 110 v. circuits. Air had to be brought into security vault area containing over 3-billion in cash and securities, without piercing thick concrete wall around area with duct supply or return.

Fig. 1: *Model of new 500,000 sq. ft. building of National Bank of Detroit. Building has dual duct, high velocity system installed.*

The new 14-story headquarters building for the National Bank of Detroit in downtown Detroit incorporates an interesting high velocity dual duct air distribution system that can be effectively controlled from one central point.

Engineers designing the air conditioning system were faced with the usual complex problems encountered in a downtown office building plus the problem of ventilating a sub-basement vault containing approximately $3 billion in cash and securities without breaching security walls, and offsetting a 500,000 Btuh internal heat gain from lighting on the 26 ft. high ceiling on the main banking floor.

The dual duct system circulates hot and cold air through parallel ducts throughout most of the building. It was selected over other available systems, according to F. A. Sando, resident engineer for the bank, because it offers rapid response to changing solar loads and represents the system most flexible to individual comfort demands in private offices.

As against a water circulation system, he said, it eliminates outside grilles under windows, reduces the number of small motors required, thus lessening maintenance problems, and seems superior to many other systems in keeping operational costs to a minimum.

The Air Conditioning System

When occupied this summer, the building will be used entirely for banking purposes (See Fig. 1). It will have an ultimate population of 4,000 persons.

To air condition it, one 400-ton and two 800-ton water chillers were installed in the penthouse. The 400-ton centrifugal unit can handle minimum requirements for odd-hour shifts during spring and fall seasons. Combinations of the three can handle any cooling load without overloading any one of the three compressors.

There is plenty of extra refrigeration capacity in case of a breakdown. Total heat gain was calculated at 1,200 tons and total heat loss at 30 million Btu. Design conditions were 95 F d.b. and 75 F w.b. in summer and -10 F in winter. Interior design are 80 F d.b. and 67 F w.b. with 50 percent r.h.

Chilled water is supplied through a common closed loop system to cold deck coils in 23 air circulating systems throughout the building at temperatures between 42 F and 46 F. (See Diagram A.) Refrigeration compressors can be modulated by the engineer on duty from 10 percent to full capacity by using hot gas bypass. A variable vane controls amount of gas bypassed or run through the compressor. Cold water temperature determines operation of the units.

Air handling units are clustered in three locations. Five in the sub-basement deal with vaults and maintenance area there and the small loan department and parking garage in the basement. Ten are in the fourth floor fan room and eight in the penthouse fan room.

How Air Is Handled With Dual Ducts

In the dual duct systems, predetermined amounts of fresh air are mixed with predetermined amounts of recirculated air and then passed through a mechanical, cleanable filter and an electrostatic air cleaner. Filtered air is drawn through a high velocity airfoil fan and then divided so that proportional volumes pass over a hot deck steam coil and a cold deck chilled water coil.

Hot and cold air then travel through parallel ducts at 4,000 to 6,000 fpm at 6 in. static pressure to the spaces to be conditioned. High static pressure compensates for pressure drop through relatively small ducts on long runs.

In interior zones, air is fed into mixing boxes located in the space between ceiling and floor slab.

There, it is mixed to desired room temperature and diffused through ceiling diffusers behind custom made metal pan ceilings having 11 percent free area (See Fig. 2).

On the main banking floor, however, a grid of aluminum, hexagonal cell lighting diffusers, hangs about 20 in. below the ceiling proper, hiding lighting channels mounted on the ceiling. Ducts running through a piping space above the ceiling introduce air through standard diffusers on the ceiling.

In Perimeter Zones

Separate systems handle perimeter zones. Hot and cold deck air is fed into under-window mixing boxes (See Fig. 3), mixed to desired temperatures, and diffused to the room through a narrow ½-in. slot 32 in. long. Mixing boxes change velocity energy to static energy so that air is introduced into the office space at low velocity, usually 150 fpm, to control air noise. A manually operated deflector directs air either up the window to counteract downdrafts or out into the room.

Helical spring dampers on each mixing box adjust the amount of hot and cold air supplied to it in response to room thermostat demands. Each box is also dampered to supply constant air volume to the conditioned space.

Constant Volume Control—What It Does

Something relatively new, constant volume control, is expected to prevent disturbing changes in static pressure. These might occur when a whole series of boxes shift from hot to cold, but one box at the end of the line is not called up to shift with them at the same time.

In such a case, the end box would normally re-

(Please turn to following page)

CREDITS

Mechanical Consultant: T. W. Bradford

Architect & Engineer: Albert Kahn Associated Architects & Engineers, Inc.

Architectural Contractor: Bryant & Detwiler

Air Conditioning Contractor: J. Brodie & Sons Co.

Heating Contractor: Glanz & Killian

Plumbing Contractor: Shaw Winkler Co.

EQUIPMENT INSTALLED

Compressors and water chillers: Worthington Corp.

Cooling tower: Marley Co.

Cooling, steam coils: Aerofin Corp.

Heat exchangers: Patterson-Kelley

Fans: American-Standard Industrial Div. (American Blower)

Mixing boxes and under-window diffusers: Connor Engineering Corp.

Ceiling diffusers: Connor Engineering Corp. and Pyle-National Co.

Electrostatic air cleaner: Westinghouse Precipitron

Mechanical filters: American Air Filter

Control console: Johnson Service Co. and International Business Machines

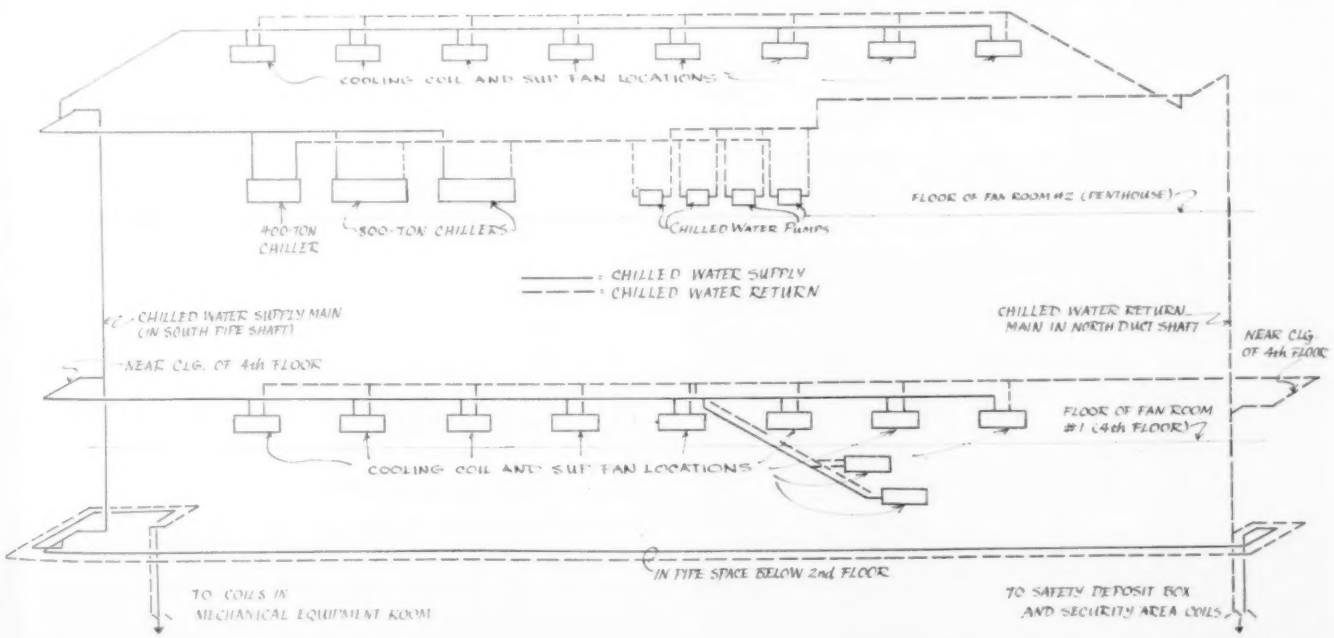
Vestibule ventilating units: Trane Co.

Motors: General Electric Co., Delco Products Div., GM, Allis-Chalmers Mfg. Co.

Pumps: Allis-Chalmers Mfg. Co. and Aurora Pump Div., New York Air Brake Co.

Steam traps: Sarco and Wright-Austin Co.

Diagram A: *Schematic flow chart of chiller water circuit to coil and fan systems located throughout building.*


COOLING COIL AND SUP FAN LOCATIONS
FLOOR OF FAN ROOM #2 (PENTHOUSE)
400-TON CHILLER
800-TON CHILLERS
CHILLED WATER PUMPS
CHILLED WATER SUPPLY
CHILLED WATER RETURN
CHILLED WATER SUPPLY MAIN (IN SOUTH PIPE SHAFT)
CHILLED WATER RETURN MAIN IN NORTH DUCT SHAFT
NEAR CLG. OF 4th FLOOR
NEAR CLG OF 4th FLOOR
FLOOR OF FAN ROOM #1 (4th FLOOR)
COOLING COIL AND SUP FAN LOCATIONS
IN PIPE SPACE BELOW 2nd FLOOR
TO COILS IN MECHANICAL EQUIPMENT ROOM
TO SAFETY DEPOSIT BOX AND SECURITY AREA COILS

Hot and cold deck air for centrally located office areas is modulated in the mixing box shown above. Helical spring damper controls air temperature from mixing box at demand of room thermostat.

(Continued from preceding page)

ceive an overdose of hot air, making it difficult for its thermostat to exercise control.

To avoid this, the constant volume control, a static pressure regulator connected to the damper motor in each mixing box, compensates for static pressure changes in the mixing zone to maintain a constant volume of air.

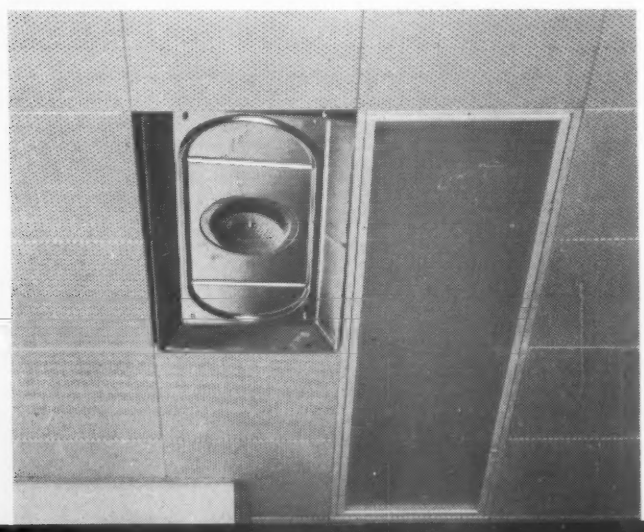
Thus, when thermostat on last box says not to close down the hot duct damper, constant volume control closes it down anyway, just to limit the volume of air. This does not affect temperature but maintains volume to design cfm.

Central Control Console "Brain"

Control of air distribution throughout the building can be handled by a single engineer seated at a console on the fourth floor right next to the engineering offices.

Control console is not just a monitoring board, but an actual control center (See Fig. 4). From here, the engineer can start or stop any or all of the 23 fan systems, adjust hot deck temperatures in any system, and, through the operating engineer in the penthouse, control operation of the refrigeration system.

Fig. 2: From mixing boxes over dropped ceiling, tempered air goes to diffuser shown above, and through specially designed perforated metal pan grid having 11 percent free area.



He is also master of the snow melting system and pneumatic tube system.

The control console cost the bank an extra $40,000, Sando remarked, but the bank will get its money back in only a few years. The console will mean a saving of two men per year, or about 10 percent less than normal operating costs for a building of this size (538,000 sq. ft., gross).

Though the console is a mass of dials and buttons, reading it will be a simple matter. Dual pointers on gauges will indicate both the temperature a system was set to maintain and the actual temperature in the conditioned space. Any variation from desired temperature is instantly visible.

As shown in Fig. 4, space temperature dials are on the lower right with start and stop push buttons above them. In the center are hot and cold deck temperature dials with adjusting switches. On the left are water and steam temperature, outdoor temperature, electrical ammeters, voltmeters, and counters. On lower left is refrigeration system diagram.

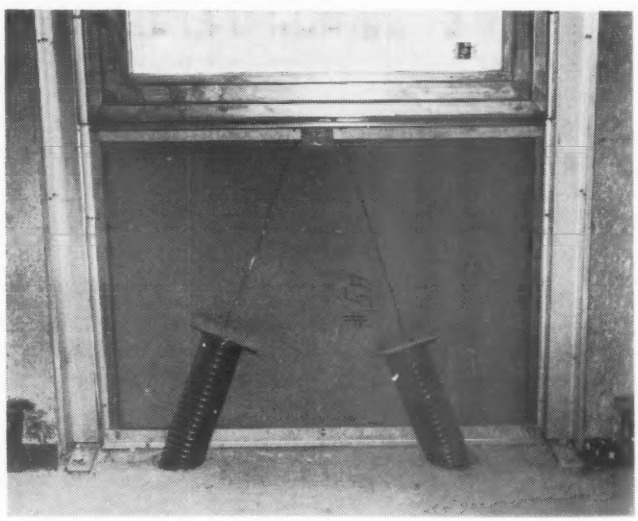


Fig. 3: Under-window mixing boxes are fed hot and cold deck air, with temperature of mixed air controlled by room temperature requirements. Air volume is kept constant by static pressure regulator.

All major and critical areas of the building are represented on the console. To make corrections in any area, the engineer has only to push the appropriate button. That starts or stops fan or pump motors anywhere in the building. Turning switches in the center of the console modulates steam valves on hot deck coils.

Only hot deck temperatures are regulated because the refrigeration system has sufficient capacity to reduce the building temperature to operating minimum if necessary.

Modulating the hot deck covers a sufficient range to give any desired room temperature.

On occasions when entering air needs no further cooling, chilled water supply can be shut off at the coil of any system. This avoids unnecessary use of refrigerating machinery.

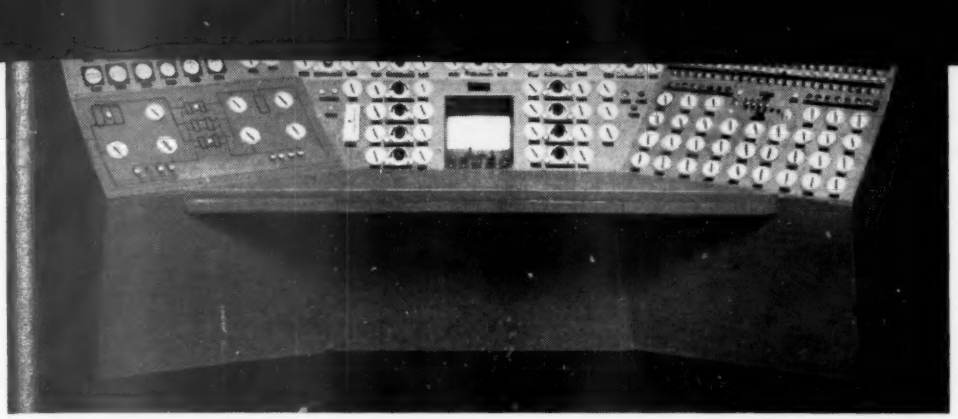


Fig. 4: Central control console from which engineer can stop or start fans and blowers on any one of the 23 fan and coil systems. Hot and cold deck coil temperatures can also be regulated here.

On such occasions, the engineer at the console can employ an electronic communications system to reach an operating engineer. Each man carries a pocket receiver.

He picks up the telephone and gives to operator the set number of the man he wants. She pushes a button causing that set, and only that set, to "beep," no matter where in the building that man might be. Hearing the beep he goes to the nearest telephone for instructions.

Electronic, Remote Motor Controls

Starting and stopping motors is accomplished through an IBM system of dual coded relays. An electronic transmitter in the console superimposes a high frequency impulse over the building's 110-volt circuit. This energizes a relay mounted near the motor. The relay, in turn, energizes the starter coil, allowing the fan or pump to be started.

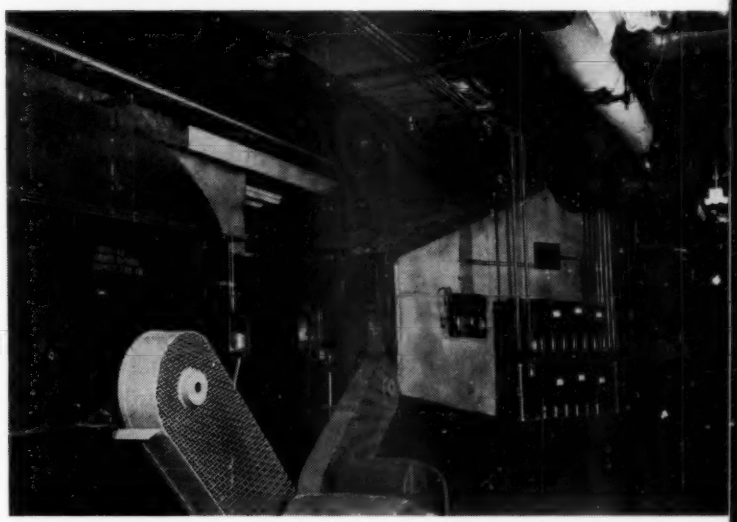
Six command coded impulses are transcribed over a single channel. They can be programmed together so that by switching the channel selector and pushing a single button, any one of the motors or all together can be started or stopped.

Automatic Memory

Another feature of the console is a screen in the center on which any one of 50 color diagrams can be flashed by a push of a button. Projector is located in the base of the console.

Slides cover all fan systems, control systems, refrigerant circuits, cooling tower circuits, pump systems, pneumatic tube systems, fire protection systems, and electric systems.

For example: If the engineer wishes to refresh his memory of what areas fan system 23A serves, or what system covers the west side of the sixth floor, he merely pushes a coded button and that diagram flashes on the screen.



Above: One of the 23 fan and coil systems throughout building. Air is filtered ahead of coils by electronic air filter unit.

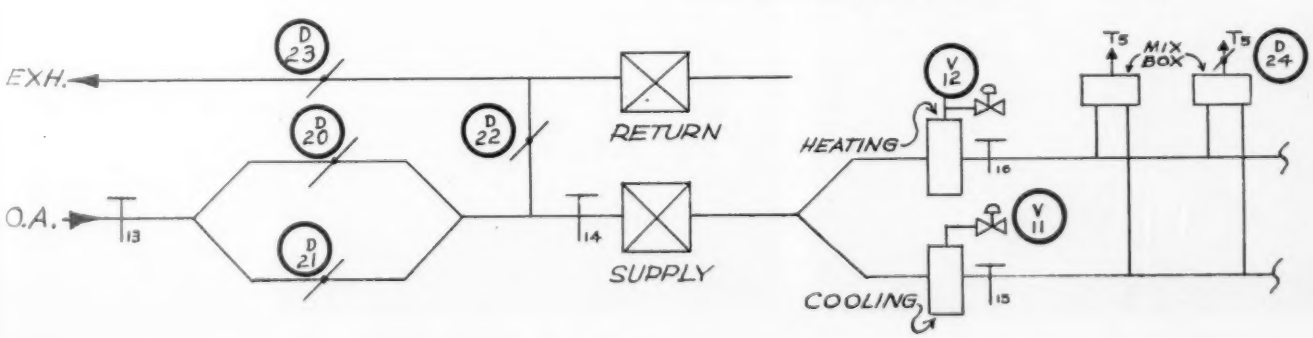
Dual Duct Control System

In a typical dual duct system (See Diagram C), starting the supply fan energizes a solenoid air valve. The valve opens the minimum fresh air damper (D 20), allowing 25 percent fresh air to enter the system, mixing with 75 percent recirculated air.

A thermostat (T 14) in the mixed air chamber

(Please turn to page 78)

Diagram C: Schematic of basic control system. Cold deck temperature is maintained constant, with hot deck varied as needed. Mixture of return, outside air depends on season, temperature needs.



by Gilbert A. Kelly, *Chief Engineer*, and
Roland W. Brown, *Design Engineer*
Surface Combustion Corporation

Hospital Air Can Be Germ-Free

Cross-infection of air in hospitals from wards, operating rooms, outside air may now be ended with the system described in this article, LiCL air wash.

Missing link in the chain of protection forged around patients in hospitals is the air itself.

Air in hospitals is not neutral. It provides the means of transportation for passing organisms from carriers, from floors or bed rails, etc., to patients, and for cross infection between hospital departments. Even air conditioning systems themselves provide a place for organism incubation and growth.

How to effectively sanitize this air – especially in operating rooms – has been the subject of several years research.

Research has been conducted at the University of Toledo and in hospitals, working with the advice and under constant checking of national hospital authorities and government agencies.

Wet Surfaces Defeat Germicidal Effect

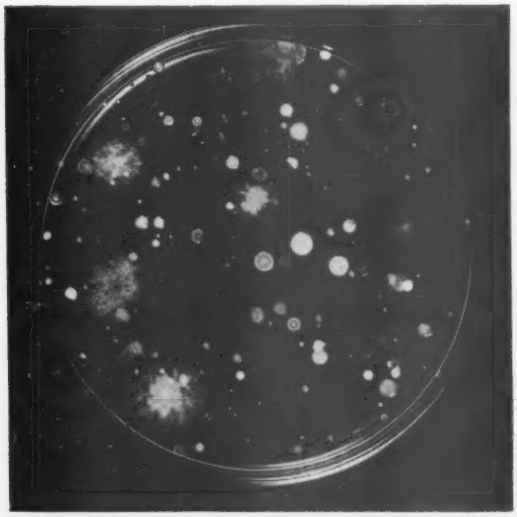
Hospital tests uncovered the incubating and contaminating effect of existing hospital air handling systems. Sources of contamination are the wet condensing coils and wetted surfaces which are part of the commonly accepted methods of humidifying or adding moisture to the air.

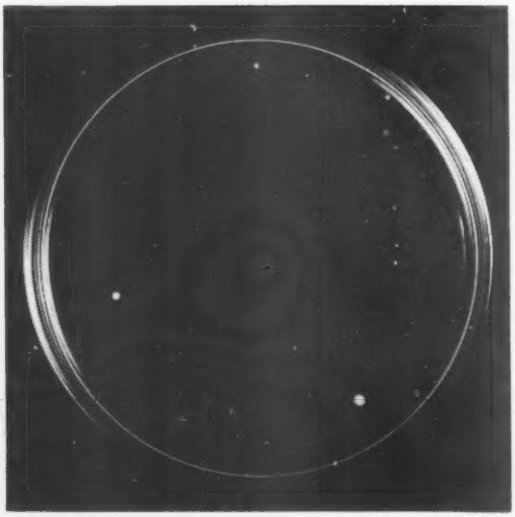
It was found that even where a unit using a lithium chloride wash reduced airborne micro-organisms from an average of 140 organisms per 10 cu. ft. to less than 5 organisms per 10 cu. ft., a humidifier located immediately after this unit brought the population of micro-organisms back to over 95 per 10 cu. ft.

This was typical of findings where wetted surfaces after electrostatic filters, irradiation plenums, and lithium chloride units were undoing what good was being accomplished by other protecting equipment.

On the basis of these studies, it is indicated that exposed water in hospital air conditioning systems should be condemned*.

**More detailed information on this study is contained in a special letter from the Research Foundation, University of Toledo, dated June 2, 1958, entitled*

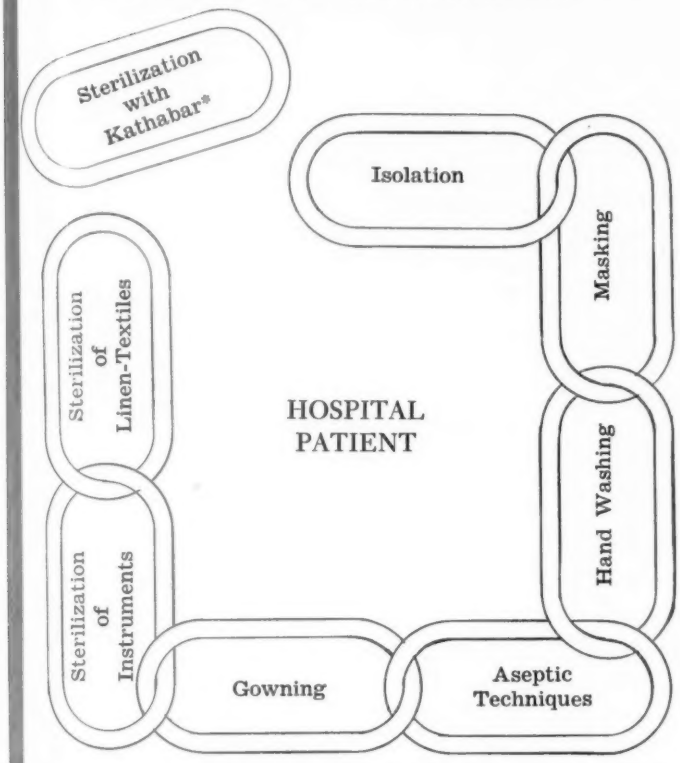




Left: *Bacteria count 195 colonies. This count made from bacteria colonies shown which were developed, after incubation, from a sample of untreated room air.*

Right: *Bacteria count 5 colonies. These bacteria colonies developed from an identical sample of room air passed through an LiCl wash.*

CHAIN OF HOSPITAL PROTECTION



*1. *Maintains air at lowest consistent population of micro-organisms yet practical.*
2. *Eliminates all contaminating wetted surfaces.*
3. *Provides most accurate control of humidity for prevention of explosions.*

"Contamination Effects of Exposed Water on Coils and Humidifiers."

Lithium Chloride Performance

Continuing elaborate quantitative tests on the bactericidal effect of lithium chloride on airborne micro-organisms indicate that a combination of the lithium chloride solution and the Kathabar unit design, made by Surface Combustion Corp., will consistently reduce the population of airborne micro-organisms from as high as 140 to 150 per 10 cu. ft. to less than 5 per 10 cu. ft.

These tests have made it practical to guarantee that delivered air to a hospital operating room will not exceed 5 organisms per 10 cu. ft. They have also shown that the bactericidal efficiency of lithium chloride solution is not affected by age or condition of solution, or whether the unit is on a dehumidifying or humidifying cycle or simply in equilibrium with the contacted air stream.

The tests also indicate that with air delivered to an operating room at not to exceed five organisms per 10 cu. ft. as measured by the all glass impinger, and on the basis of 12 to 15 air changes per hour, it is practical to hold an operating room with occupancy of eight to 10 people at not to exceed 10 organisms per 10 cu. ft.

The tests showed that outside air is not free from pathogenic or harmful micro-organisms as is generally assumed. Most hospitals' 100 percent fresh air systems are actually, pathologically speaking, 100 percent recirculated air systems.

Even though such counts of pathological organisms are usually low, in conventional air conditioning systems they find the proper environment and nutrients for existence and propagation. Actual counts show consistently higher population of pathological organisms than there is in correctly treated inside air.

The study indicated that proper air distribution and faster air circulation through a lithium chloride unit, when it is last in the air handling line, can be an effective counter measure against these organisms released to the air in the conditioned space. These organisms are released by cleaning, by a carrier, by sneezing, by coughing, by an operation, or by changing a dressing. Approximately 15 air changes per hour are indicated.

How the Kathabar System Works

As shown in the cutaway drawing on the following page, supply air or air to be conditioned is drawn in and passes through the heating and cooling coils of the conditioner which are continually washed with Kathene (lithium chloride) solution.

Temperature of the air leaving the unit is controlled by passing a coolant, such as chilled water, to the cooling coil, or steam to the preheat coil. The preheat and afterheat coils are not furnished with the unit.

Moisture content of the air is controlled by the concentration of Kathene solution. Required concentration is maintained automatically during operation.

Heating coil in the conditioner supplies only heat for humidification. Makeup water for the Kathene solution during humidification is obtained from the coil when steam is used. Steam condensate or distilled water may be used for makeup water. Low

(Please turn to following page)

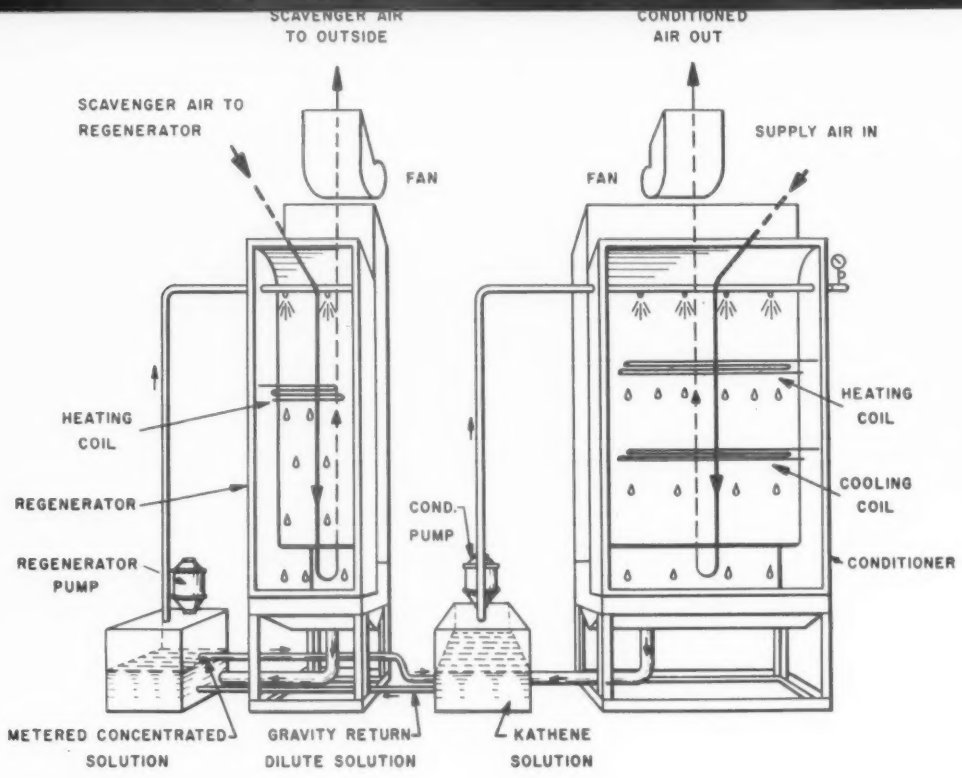
Bacteria Types Killed
By Kathabar Unit
Per Actual Test

PATHOGENS

Staphylococcus Albus
Staphylococcus Aureas
Streptococcus Pyogenems
Pseudomonas Aeringinosa
Klebsiella Pmemoniae
Clostridium Welchii

NON-PATHOGENS

Staphylococcus Citreus
Aerobacter Aerogens
Escherichia Coli
Proteus Vulgaris
Bacillus Mycoides



Lithium chloride unit sanitizes hospital room air. Air to be conditioned passes through heating and cooling coils in unit while coils are being washed with lithium chloride solution. Moisture content of air is controlled by concentration of lithium chloride solution.

(Continued from preceding page)

pressure steam or hot water can be used in the heating coils.

Moisture removed from the air by the Kathene solution increases the level of solution in the system. Rise in level actuates controls to pass steam or hot water to heating coil in regenerator. Solution flowing over coil is heated and moisture is driven from solution into scavenger air and carried outdoors.

Level of solution in system decreases due to removing moisture from solution in conditioner during humidifying operation. Drop in level actuates controls which pass steam to heating coil in conditioner. Steam condensate then passes into Kathene solution to automatically maintain required concentration. When separate source of makeup water is used, heat for humidification is still supplied to heating coil in conditioner.

During dehumidifying operation, absorption of moisture from air will dilute solution in conditioner. Warm concentrated solution from regenerator is metered into dilute solution to automatically maintain required concentration. Metering minimizes additional cooling required.

Summary

In summary, a lithium chloride unit provides these protective factors:

1. By thoroughly scrubbing air with germicidal

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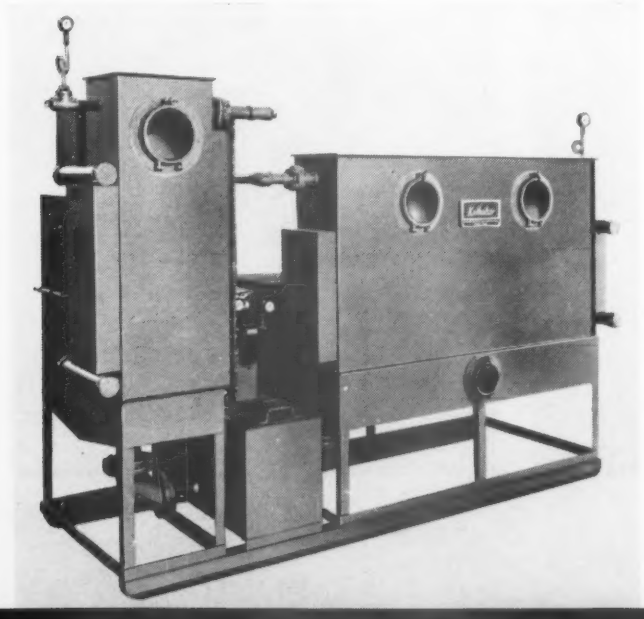
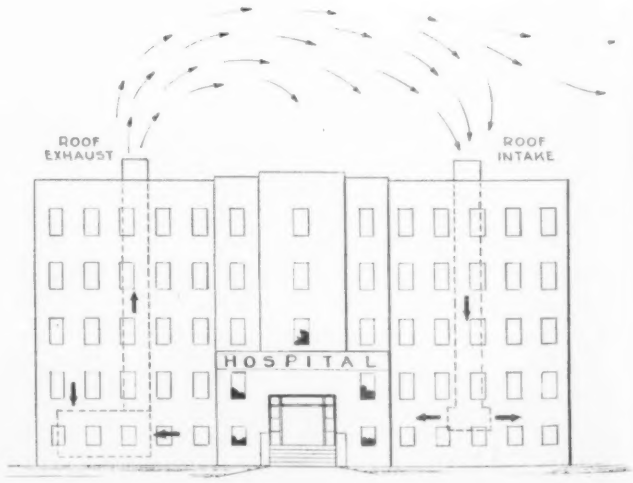
Below: *Kathabar unit for accurate control of relative humidity of conditioned air for hospitals, has also been found to be effective in viability of airborne pathogenic bacteria of many types.*

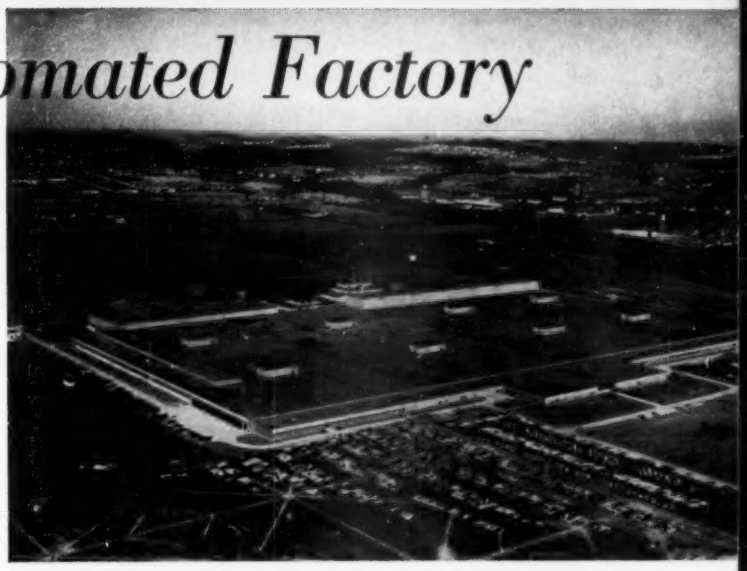




Ventilating an Automated Factory

by R. E. Lee
Manager, Unit Heater Sales Department
The Trane Company

Automation in this automatic transmission assembly plant poses high heat gain problems. Here is a solution, with unique heating, ventilating, air conditioning system in new Ford plant.



New automatic transmission manufacturing plant of the Ford Motor Company, near Cincinnati, has more than 40-acres under one roof.

Increasing use of automation in the modern industrial plant has resulted in appreciably higher heat gains than were common with formerly prevalent manufacturing methods. Overcoming this heavy heat load, imposed by electrically-driven automatic machinery, was a major problem that had to be solved in order to provide good working conditions for factory employees of a new Ford Motor Company plant.

The new 1,668,000 sq. ft. plant is the latest manufacturing facility in Ford Motor Company's Automatic Transmission Division. Located near Sharonville, Ohio, it presently employs close to 4,500 people in production of automatic transmissions for Ford Motor's cars and trucks. Employment is expected to reach 6,000 by the end of 1959.

It was estimated that the automation to be used in the manufacturing area of the Ford plant would create a heat load of approximately 85 Btu/sq. ft. of floor area. Following is a discussion of how this problem was solved by a unique heating-ventilating system in this plant.

Generally accepted method of reducing temperatures during summer months in this type of plant has been to introduce outside air into the building through various types of make-up units. The air is then discharged inside the building at truss level at sufficient velocity to reach the working level below. Hot air which is replaced by this ventilation air is then exhausted at roof level through power exhausters.

The problem in driving this air down to the worker's level is its tendency to aspirate hot air from the upper zone of the building into the 12-ft. zone above the floor, with part of the ventilation air curling off into the truss space to short circuit to roof exhausters. Result is that very little temperature reduction is accomplished in the lower zone.

A solution was possible, if outside air could be introduced directly into the 12-ft. zone above the floor, by extending ducts through the strata of hot air. The inflow of cooler air would then force heated air up into the truss space and thence through roof exhausters to outdoors, resulting in a highly efficient cycle of air cooling.

Air Distribution Problem

The problem encountered was to find a method of invading the production space below the truss level without air ducts interfering with plant operations. A compact method of wrapping a sheet metal air plenum around building columns was developed by The Ford Company engineers. Through this plenum, air is discharged horizontally 9 ft. above the floor.

A new style vertical outlet discharges air into zones below 9 ft. without excessive residual velocity at the breathing line. The outlet was adapted to satisfy requirements dictated by Ford Motor Com-

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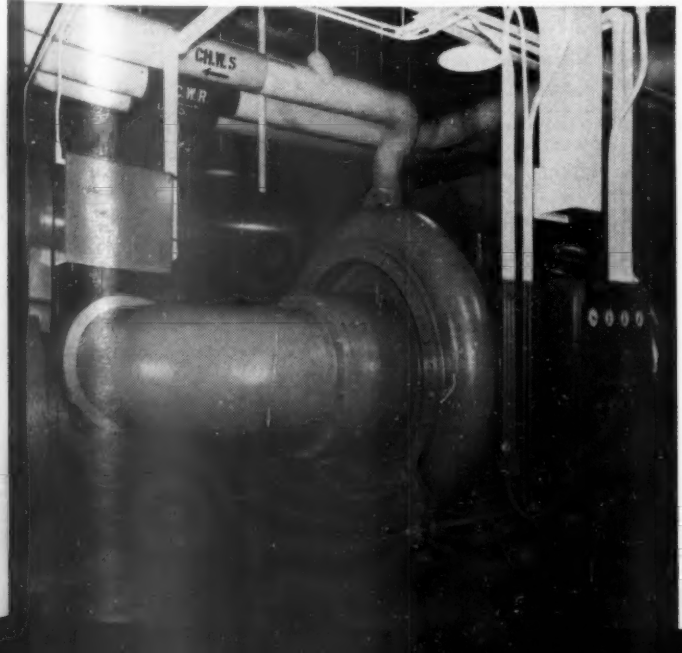


Left: *Five-hundred hp hermetic centrifugal compressor supplies chilled water to central duct office air conditioning system.*

(Continued from preceding page)

pany engineers cooperating with outlet manufacturer.

Six outlets at each plenum discharge air in as many directions to achieve complete peripheral coverage. Desired distribution was accomplished by use of 10-in. by 28-in. rotating drum-type louvers with manually adjustable blades.

The Basic System

The basic ventilating unit consists of: a blackout roof intake hood with automatic close-off dampers; a standard factory-assembled 18,150 cfm horizontal heating and ventilating unit suspended in the truss space; extended ducts to the air plenum; the air plenum around the column; and vertically-placed discharge outlets.

By the addition of a coil section, face-and-bypass dampers, steam and condensate piping and a temperature control system to the basic unit, the necessary means to temper air through a percentage of the air supply units was obtained. With these winter supply units, provision was made for comfort ventilation during the winter as well as for replacement of air lost through process exhaust.

Total air supply capacity of all ventilating systems provides eight air changes per hour in the general factory areas, based on gross building volume, during mild weather.

Heating coils in the basic unit of the heating-ventilating systems are sized to handle outside air based on 125 percent of exhaust system's net capacity.

Room-mounted summer exhaust units have been provided with total capacity to match the supply, minus amount of air removed by process exhaust.

Special Area Treatment

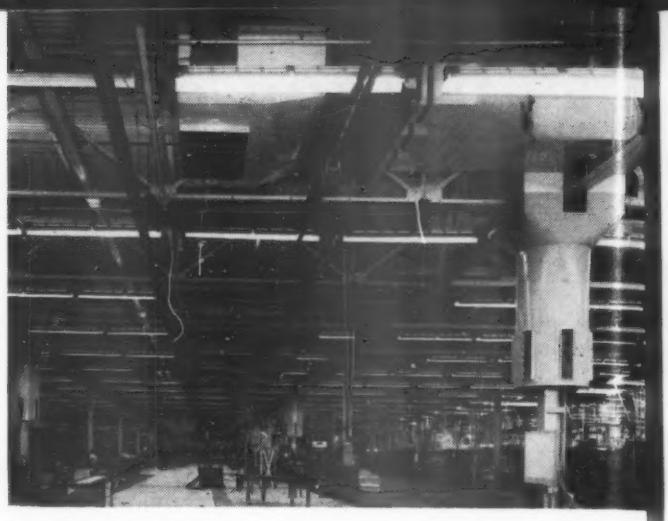
Ventilation in a heat treat area of the factory is based on 12 air changes per hour. Power roof ventilators and supply units located in the truss space provide this ventilation, together with supplemental heating units used for night and week-end duty.

Large doors in exterior walls of the factory are blanketed with a curtain of heated air by means of unit heaters and ductwork. Unit heaters are sized on the basis of 3,000 Btu per hour per square foot of door opening area, and discharge at sufficient velocity to counteract normal inflow of outside air when doors are open.

A large garage area attached to the main plant area is heated and ventilated by outside air make-up units with adjustable mixing dampers for varying percentage of return and outside air.

Fifty percent of the garage air is exhausted by power roof exhausters with ducts extending down to within 1 ft. of the floor. The balance is exhausted by power roof ventilators. Total fan capacities provide six air changes per hour and heating coils are sized for 100 percent outside air.

Air conditioning in the office area of the Ford plant is accomplished with low velocity central duct systems that supply conditioned air to various zones through ceiling diffusers.



Above: *Manufacturing area view shows basic heating-ventilating system consisting of mixing box, heating-ventilating unit (above plenum) and outlets 9 ft. above floor level. Note sheet metal outlet box wrapped around building columns to get air down to breathing zone.*

All supply air diffusers and return air grilles in office areas are integrated into a modular pattern so as to permit partition rearrangements, when necessary, without major revisions in the conditioning system.

Separate heating and cooling coils are used in each factory-assembled office air handling unit. Heating coils are sized on the basis of 10 psig saturated steam at the coil inlet and handle 25 percent outside air at winter design conditions.

Chilled water is supplied to the cooling coils of the central office air handling units by a 500-hp hermetic centrifugal compressor. Output of the cooling coils is controlled by three-way modulating valves. The refrigeration machine has a design capacity of 570 tons to chill 1140 gpm of water from 57 F to 45 F when supplied with 1710 gpm of condenser water entering at 85 F and leaving at 94.6 F. Operation of the machine is completely automatic.

Supplementary heating is provided for perimeter office zones by hot water, fin-tube radiation in wall-hung cabinets. The radiation is centrally located in modules to allow partition movement without alterations of the heating system.

CREDITS

Architect-Engineer—Giffels and Rossetti, Detroit, Michigan

Contractor—B. A. Walterman Company, Cincinnati, Ohio

EQUIPMENT INSTALLED

Factory Blower Unit Heaters—Trane Torrivents

Office Air Handling Units—Trane Climate Changers

Office Refrigeration Machine—Trane Hermetic CenTraVac

Office Perimeter Heating—Trane Wall-Fin

by Robert H. Avery*
Director, Application Engineering
Cambridge Filter Corporation

The Meaning of "Clean Air"

Do you have a "clean air" problem? Here's the first of a three-part series on dust-free "white" room design for assembly areas where ultra-clean air is a "must." Clean air criteria, dust measurement and filter selection data will be presented.

The metal-working and electronic industries have always had requirements for "clean" areas. In many cases these requirements presently are being served by supplying air which has been filtered through panel impingement type of filters. Typical of this application is the assembly area for automatic transmissions for certain automobiles. Other areas such as spectroscopy laboratories have been served adequately by the use of air filtered by electronic air cleaners. In most of these cases, area pressurization without any supplementary techniques were adequate to get the level of dust concentration down to an acceptable point. The coming of the "space age" has brought with it the requirements for inertial guidance and other equipment which must operate on practically friction-free bearings. The achievement of such low friction levels requires cleanliness technique heretofore considered impossible to achieve. When bearing comparators are available to measure dimensions to one millionth of an inch, a micron (1/25,000 of an in.) usually considered a minute value, becomes a large number. Similarly, particles of dust one micron in diameter may constitute gross contamination of the air.

*About the author: *Robert H. Avery has had over 12 years' experience in field application of dust collecting, heating and ventilating equipment. He was active for three years in the fields of industrial hygiene and public health, serving in this capacity with the Michigan Department of Health, St. Louis and Kansas. He holds AB and MS degrees in chemistry.*

In addition to this, the miniaturization of electronic equipment by the use of transistors and other semi-conductors has led to requirements for dust free levels based not so much on soiling as on the associated problem of chemical contamination. Even the slightest contamination (measured in parts per 100 million) will affect the performance of transistors.

A discussion of dust free or "white rooms," as they are frequently called, usually involves the following considerations:

1. The air conditioning system – with special emphasis on techniques aimed at being certain that the air supply to the room is as dust free as possible.
2. Special construction of the room itself.
3. Personnel techniques to prevent contamination in the area itself.
4. Material handling techniques to be certain that the product can not be subject to accidental contamination.

The data which follows will be concerned pri-

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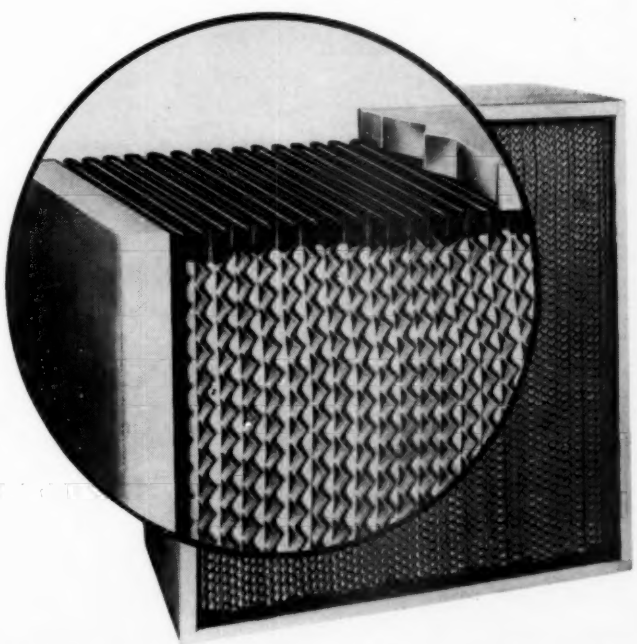
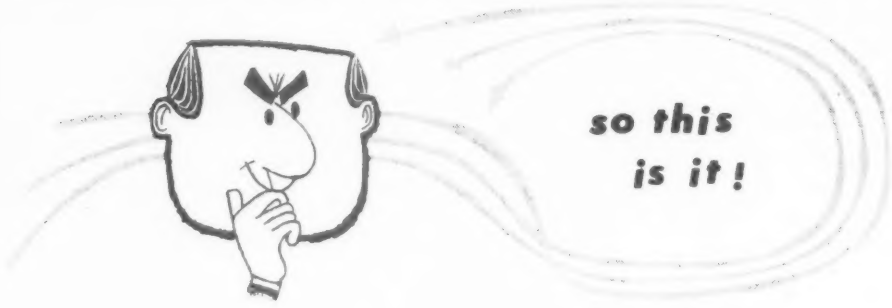


Fig. 1: Cut-away view of a typical super-interception type filter, Cambridge ABSOLUTE.®

THE AIR AROUND US



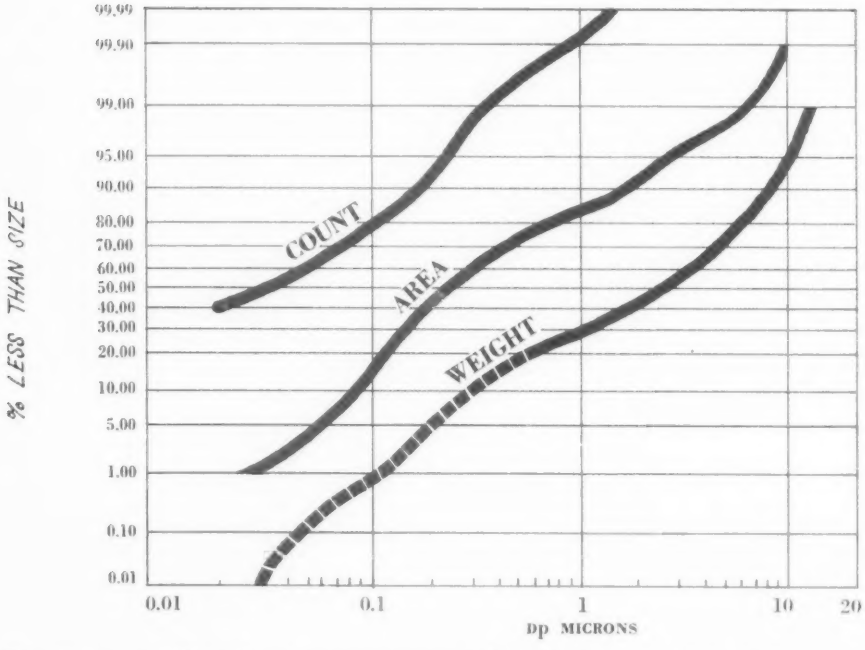


Table 1: Typical distribution of dust particles in room air. Note difference of concentration based on manner in which this concentration is expressed. Compare counts on weight vs count basis.

Count curve: *Based on measurements by electron microscope*
Area curve: *Calculated*
Weight curve: *Solid section based on measurements by sedimentation. Broken section calculated.*

(Continued from preceding page)

marily with the first of these items, but the other three will be outlined because only when every possible precaution has been taken in every aspect can one be assured of a truly "dust free room." Laxity in even the smallest technique can frequently destroy all the good effects secured by meticulous care in all other operations.

Since the first requisite for a dust free room is clean air, it is important to consider the distribution of dust particles in the atmosphere. Table 1 shows such a typical distribution by particle size. The relative concentration of these particles can be expressed on either a weight, area or count basis. Note the difference resulting from the manner in which the concentration is given. For instance, on a weight basis, particles smaller than 0.5 microns constitute only 20 percent of the dust particles in the atmosphere. However, on a count basis they constitute more than 99.5 percent of atmospheric dust.

Although industry has been searching for specifications which would clearly define the tolerable amount of dust in a given area, and the acceptable particle size distribution of this dust, such standards have not generally been resolved. As a result, most people who have been concerned with the problem of maintaining dust free rooms have adopted the attitude that the room must be as dust-free as possible, recognizing that this approach will most frequently achieve the desired results. One will find in the literature and in general practice such phrases as "control to a particle diameter of one micron" but these are nebulous phrases without any exact scientific meaning. If it were possible to do so, a specification for dust concentrations should include a breakdown of particle sizes, and the maximum allowable count for each particle range.

Knowing the particle size distribution of dust in

the atmosphere, and having determined the required distribution in the "white room," the next step is to select the air filter or combination of filters which will remove enough of the atmospheric dust particles to achieve this desired result.

In discussing dust free rooms it is convenient to classify air filters by the method chosen to rate the filters in describing their efficiency. Most filters intended for non-critical areas or as prefilters to higher efficiency air cleaners, are rated on a weight method. Testing dusts and methods vary, but essentially this technique consists of feeding a given amount of dust into an air stream, and determining the weight of the test dust collected by the filter. This can be done either by weighing the filter before and after the test or by an indirect method. Since the distribution of dust in the atmosphere is such that by weight 75 percent of all particles in the atmosphere are greater than one micron, it would follow that 100 percent of all particles down to this size would still allow 25 percent penetration. As a matter of fact, most synthetic dusts have one micron particles as their lower limit, and on this basis it can be seen that even if a filter were 100 percent efficient on such synthetic dust it would probably still pass 25 percent of all the dust in the atmosphere.

Electronic Air Cleaner Performance

Discoloration efficiency (using atmospheric dust) is used for determining efficiency of electronic air cleaners and fine-fibered glass media interception filters. In this test, air is sampled simultaneously upstream and downstream of the air filter being tested. These samples are passed through separate Whatman filter papers. The sample taken upstream of the air filter being tested will, of course, be much dirtier and consequently soil the filter paper at a much more rapid rate than the sample taken downstream. Air flow may be kept constant, and areas of sampling papers varied so that both papers soil at the same rates; or Whatman filter papers may have the same areas, and sampling rate changed so that the soiling of both filter papers is the same. In either case, a ratio of the two variables can be established and expressed as a discoloration efficiency. While not a direct measurement, it will be noted that discoloration efficiencies correspond to the effectiveness of filters in removing dust expressed on an area basis, since soiling is, for all practical purposes an "area" measurement.

In the past, most electronic air cleaners intended for air conditioning systems have been designed for a discoloration efficiency of 85 percent. By reducing the velocity of air through the same electronic air cleaners it is possible to achieve efficiencies of 90 percent. Certain manufacturers now have available units with reduced plate spacing and modified ionizer design which they contend will give efficiencies even higher than this.

Even the high efficiencies (by conventional standards) available by the use of electronic air cleaners and glass-fibered interception filters have not been adequate for many of the critical requirements established by modern industry. Fortunately, a new super interception filter, itself a product of the Atomic Age,

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Fig. 3: Typical industrial dust free room. Note absence of ledges and smooth, easily cleaned surfaces. Photo courtesy Kearfott Company, Inc.

Fig. 4: Special dust free hoods for precision assembly work. Louvered panels are for control of flow of pressurizing air. Note that worker has latex finger cots. Photo courtesy Kearfott Co.

(Continued from preceding page)

is available to meet these more exacting requirements. This special filter has gone through many improvements since it was first developed for the Atomic Energy Commission for the removal of radioactive dust. Its basic design, however, is still unchanged in that it consists of a special filter paper pleated back and forth over corrugated spacers and sealed into a dust tight frame (Figure 1). Because of its very high efficiency, this filter media has a correspondingly high pressure drop, but sufficient media is incorporated into a filter so that when it is operating at its rated capacity, the velocity of the air *through the media* is about 5 fpm. Under these conditions the filter pressure drop is reduced to 1.0 in. w.g. when the filter is clean.

The Meaning of "0.3 Micron Particles"

The efficiency of this type of filter, pioneered by the Cambridge ABSOLUTE® filter, is so high that none of the known efficiency evaluating techniques were adequate to rate it. A new technique was developed by the Chemical Corps and others using dioctyl-phthalate aerosol as the testing material. In this test, air containing a uniform dispersion of dioctyl-phthalate (D.O.P) particles 0.3 micron in diameter is fed to the filter. By optical methods the aerosol concentration is determined upstream and downstream. Using photo multiplier tubes and suitable circuits, it is possible to record penetration as low as 50 ppm of original smoke concentration. In order to meet government standards, all filters of this type are tested individually, and can have a penetration of no more than 300 ppm (an efficiency of 99.97 percent) on these 0.3 micron particles.

Theoretical studies by Langmuir and others indicated that the most difficult particles to remove from an airstream would be those which were approximately 0.3 microns in diameter. Such particles would be too small to be removed by any inertial influences, and yet would be too large to be subjected to molecular influences. Actual studies have indicated that 0.3 microns may not be the most difficult, and there are many who feel that 0.1 micron or slightly smaller particles "deserve the nod." However, within this general range exists the particle size least subject to capture influences. Most people recognize that particles larger than this range will be captured with efficiencies greater than 99.97 percent. However, they frequently are of the opinion that the efficiency on particles lower than 0.3 microns falls off rapidly, and that this particular size was taken because it was the breakoff point. This is not the case. Actually, particles smaller than those of the minimum capture size will be collected with efficiencies higher than 99.97 percent, and the penetration will increase again only as aerosols approach molecular size.

Part II of this article will appear in the May issue of AIR ENGINEERING.

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Air Pollution Control and the Metal Working Industry

by Fred Rehm

Deputy Air Pollution Control Engineer
Milwaukee County, Wisconsin

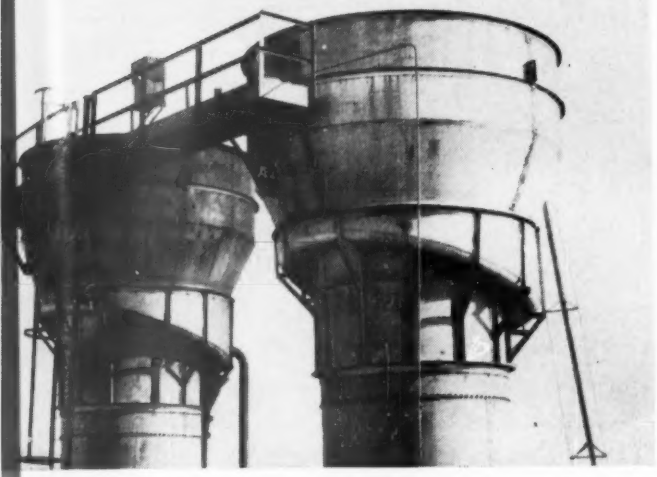

Fig. 1: Wet cap type cupola collection system effective in collection of larger particulates and in reducing fire hazards from emission of burning cinders.

Here are techniques for reducing air pollution from annealing ovens, melting furnaces, cupolas and air furnaces. Authoritative deposition studies on a foundry point up problem.

The air pollution problems of the metal working industry can be divided into two general types . . . emissions from a combustion process . . . and emissions from a non-combustion origin.

Air pollution control problems of a non-combustion origin have since the years just prior to World War II received considerable attention by industry management. Tremendous strides have been made in the matter of "in-plant" dust, fume and odor control. Competition for skilled personnel, high levels of economic prosperity, a desire for improved working conditions and better plant maintenance, have combined to stimulate installation of collection and control systems on core and mold sand handling and mixing systems; foundry casting shakeout devices; grinding, cleaning and production welding operations.

Dry Collectors

Dry centrifugal and bag type control systems have long been accepted practice in the metal working industry. It was in this post-war period that we began to see more extensive utilization of wet collector systems, and in our northern climate a trend to the recovery and reuse in ventilation of the heated air used in the dust transport systems.

At the present time, the wet dust collector has made a marked advance into non-combustion field emission problems, which earlier had been handled almost exclusively on a dry collection basis. Large particle size dust and absence of temperature and corrosive atmospheres made collection of these air pollutants a relatively easy and inexpensive one compared to those associated with combustion source emissions.

All too often, however, "in-plant" pollution problems were solved by venting directly to the atmosphere without the benefit of pollution control systems. With the addition of this non-combustion source pollution load to that already discharged from the combustion sources – cupolas, air furnaces, electric furnaces, melting furnaces, annealing ovens, pulverizing systems, core ovens, etc. – the neighborhood saturation level or nuisance level was reached and exceeded in many instances. Being a close neighbor of a

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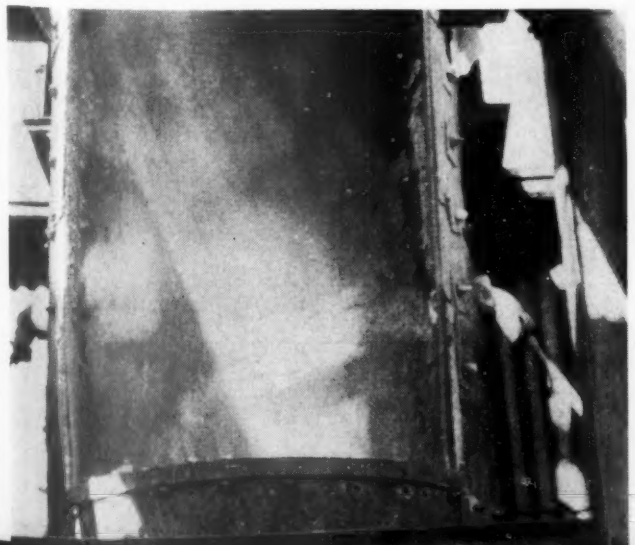

Fig. 2: Cupola stack gas oxidizer provides ignition for CO rich cupola gases prior to discharge.

TABLE I—AVERAGE PARTICULATE DEPOSITION RATES IN MILWAUKEE COUNTY
TONS/SQUARE MILE/MONTH

	1951	*1952*	*1953*	*1954*	*1955*	*1956*	*1957*
1. Agricultural Zone (4 Sites)	14.0	15.9	17.2	18.0	17.5	20.9	15.4
2. Residential Zone (19 Sites)	22.4	23.1	25.5	22.7	22.9	25.3	19.8
3. Local Business Zone (11 Sites)	36.5	34.6	34.4	30.7	30.7	34.7	27.1
4. Commercial and Light Manufacturing Zone (2 Sites)	45.8	44.8	51.0	44.0	48.3	55.5	47.9
5. Industrial Zone (15 Sites)	82.1	69.4	68.1	54.7	54.1	60.7	56.3

(Continued from preceding page)

foundry operation resulted in practically intolerable living conditions.

While economic justification existed for improving "in-plant" conditions, this was not the case, generally, for solving air pollution problems of combustion source emissions. Then, too, because of the large volumes of gaseous matter in which these particulate air pollutants were carried, cost of control equipment for these applications was, and in some cases remains, prohibitive. It seems unreasonable that an efficiently functioning air pollution control system should approach the cost of the production unit making the saleable product. Yet, this is the state of technological development of air pollution control devices in a number of metal working industry applications. This condition must improve before we can hope to get widespread installation of adequate control devices in the huge metal-working industry.

Since 1951, Milwaukee County has conducted one of the most thorough and complete dustfall or deposition rate studies in the country. At present, 68 sites are checked monthly for the fallout of particulates from the atmosphere. In addition to these regular sampling sites, special deposition rate studies have been made in and around different types of industrial plants. Table I summarizes the results of the regular deposition rate sampling program for the years 1951 to 1957.

Results of these deposition rate tests are reported in tons of dust/square mile/month. Each figure cited is the average of the 12-monthly deposition rates for the number of sites listed under each zoning category. In contrast, individual monthly deposition rates at some of our regular sampling sites have ranged to as high as 300 tons/square mile/month. We have meas-

TABLE II—SUMMARY OF DUSTLOADING EMISSION RATES FROM TWO SIZE NO. 11 GRAY IRON CUPOLAS OPERATING AT A MELTING RATE OF 16.53 TONS/HOUR AT AN IRON TO COKE RATIO OF 7.5 TO 1.*

		DUSTLOADINGS DETERMINATIONS						
		Actual Loadings Encountered					*Corrected to a 12% CO_2 Basis*	
Run No.	*Cupola Operation*	*At Sampling Conditions*		*Sampling Conditions*			*At Sampling Conditions*	
		Grains /Ft.³	*#Dust/ 1000# Flue Gas*	*Temp. °F.*	*Press. In. Hg.*	*% CO_2*	*Grains /Ft.³*	*#Dust/ 1000# Flue Gas*
1	Burn Down	0.332	2.015	1233	29.40	7.02	0.542	3.295
2	Start Up	0.227	1.102	833	29.31	6.22	0.419	2.030
3	Normal	0.326	1.712	999	29.27	7.22	0.519	2.725
4	Normal (Reduced Charge Rate)	0.234	1.376	1180	29.24	9.07	0.298	1.748
5	Normal	0.436	2.220	952	29.19	7.87	0.632	3.210
6	Start Up	0.411	1.918	830	29.17	6.56	0.711	3.350
7	Normal (Reduced Charge Rate)	0.254	1.140	785	29.13	7.78	0.378	1.700
8	Start Up	0.290	1.440	899	29.06	4.36	0.722	3.600

*Data from actual field tests conducted by the author.

Fig. 8: Cupola collection system with a high efficiency dry centrifugal separator being tested for air pollution performance.

ured deposition rates as high as 2,000 tons/square mile/month on the premises, or near the premises of some of our foundries in special studies made. Deposition rates of the order of 300 to 600 tons/square mile/month are not uncommon at such locations.

One can see from this data how important air pollution becomes in zoning considerations. For while such exorbitant deposition rates as cited can be reduced by air pollution control measures, there remains a practical, irreducible minimum which can be attained. Even these reduced rates would be near the unacceptable limit for a residential zone which bordered, without buffer zoning, an industrial area which contained many metal working operations, or other industries of equal air pollution emission potential. Because the field of air pollution control for non-combustion emissions is pretty well understood and practiced, we will confine the remainder of our remarks to the combustion sources in the metal working industry which present some difficult and trying problems of control.

Combustion Sources of Air Pollutants

Changes in operational practices and techniques offer a possibility for marked reduction in the discharge of particulate emissions in the metal working industry. Likewise changes in fuel or type of melting equipment can aid in the reduction of dust, fumes, and other particulates. As an example, we have seen a marked improvement in cupola, air furnace and annealing oven particulate discharge by the simple expedient of incorporating gas, oil, or electric *ignition* systems to replace the scrap material and scrap wood start-ups which were commonly used in this operation. Not only was the air pollution problem thus reduced, but a real fire hazard problem was eliminated. Figure 1 shows a gas torch being used to light off a gray iron cupola.

Changes in fuel or firing practices presents a more costly approach to the solution of the emission problems of the pulverized coal-burning air melting furnace and annealing ovens. Price and availability of liquid and gaseous fuels will determine whether this is the better solution to this problem, or whether the installation of a high efficiency mechanical or electrostatic dust collection system is the more practical answer to the fly ash problem associated with this type equipment. Dust collectors are not commonplace in the industry on this application.

Operating Practices

Elimination of such operating practices as decarburization, accomplished by oxygen lancing a steel furnace melt, will materially reduce the discharge of iron oxide fume to the atmosphere. To eliminate this practice, very close control must be kept over melting furnace charge material to secure a steel of the desired composition. Unfortunately, only the best organized steel melting operations are capable of this type control.

In all metal working industries – gray iron, steel and non-ferrous scrap and charge preparation, selection and processing can reduce the quantity of pollutants discharged to the atmosphere. Degreasing has become an increasingly used practice aimed at better quality control, as well as providing reduced atmospheric emissions. Figure 2 illustrates a cupola stack gas oxidizer which provides ignition for carbon monoxide rich cupola gases prior to discharge. In addition to the reduction of the carbon monoxide gas being discharged to the atmosphere, such a system offers the advantages of reducing visible emissions of hydrocarbons and providing for a longer period of high temperature retention and thus a more complete burnout of cinder and coke particles.

Reducing Visible Smoke

Extensive studies conducted in this area have resulted in the conversion of practically all of the oil fired non-ferrous melting furnaces to gas firing or electric induction heating. This has resulted in a reduction of visible smoke and soot emissions, particularly during start-up periods. At the same time, the amount of sulphur dioxide and other sulphur compounds discharged to the atmosphere have also been markedly reduced.

All branches of the metal working industry have

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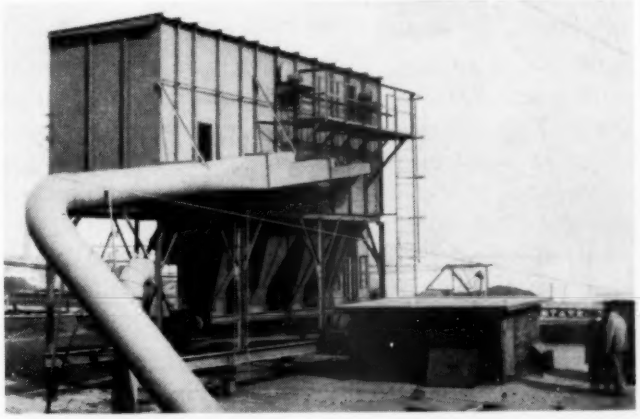

Fig. 4: Dacron bag collector on exhaust of an electric melting furnace. This is same plant as shown in Fig. 5, on next page.

(Continued from preceding page)

had an odor problem associated with the baking of linseed oil and other binders used in core formation. Continuous recirculatory type core ovens have greatly reduced these odorous emissions, particularly when they incorporate the rare metal catalysts found to reduce the auto-ignition temperatures of these odorous fumes.

(Editor's Note: For more information about catalytic units, see page 52)

In this manner, catalytic fume-burning and odor reduction is effected. This odor reduction has been effected with a savings in fuel afforded by the heat recovered from the burning of the odorous substances. Figure 3 illustrates a catalytic fume burning installation operating on a batch type core oven application.

In our efforts to aid our industry in the appraisal of the cupola and electric furnace emission problem, we soon became cognizant of the lack of competent, quantitative emission data on both these sources. Accordingly, our well-organized stack testing program went to the aid of our industry and interested collector suppliers in helping to evaluate these problems. We have long enjoyed the reputation of conducting the most detailed and thorough stack testing program that exists in any air pollution control agency in the country. We believe such a program to be a must to achieve effective control. Figure 6 shows the author and a department inspector in conducting some stack emission studies on one of Milwaukee County's approximately 100 gray iron cupolas. Figure 5 depicts the stack emission testing of the discharge from a steel electric melting furnace.

Cupola Dust Control

The nature and extent of the cupola dust emission problem is illustrated in Table II, which summarizes dustloading emission rates from two size No. 11 gray iron cupolas. The cupolas were operating at a melting rate of 16.5/tons/hour and at an iron to coke ratio of 7.5 to 1 during time of measurement.

Data was taken to show the wide range of temperatures and excess air conditions encountered in cupola operation. Temperatures ranged from 380 F to 1550 F from the cupola "start-up" to the cupola "burn-down" condition. Exit gas volume ranged in this particular unit from 52,000 to 95,000 cfm over the operating cycle. This data is significant as it illustrates the wide range of temperature and excess air condition that a collection system on this application must be designed to handle.

By developing this type of data and cupola emission particle size study, we were able to determine that a cupola dust collection system at this plant would require an overall dust collection efficiency of 85 percent, or greater, to insure compliance with the American Society of Mechanical Engineers recommended limitation of 0.85 lbs dust/1000 lbs flue gas, adjusted to a 12 percent CO_2 basis, which limitation is in effect in Milwaukee County. Table III, Cupola Dust Particle Size Analyses, is part of the data developed in the testing of this same plant and is presented to illustrate how such data is useful in defining the problem and determining the best solution.

TABLE III—CUPOLA DUST PARTICLE SIZE ANALYSES

U. S. Standard Sieve Size	Run No. 3 Per Cent Retained	Run No. 5 Per Cent Retained
#8	4.56%	2.57%
#20	9.39%	9.32%
#60	22.45%	23.32%
#100	16.65%	26.16%
#200	13.06%	14.09%
#325	11.69%	9.03%
#325	22.16%	15.46%

Cupola Emission Rate Varied

In this particular plant, and under the conditions tested, we found cupola stack emissions to range from 5.77 lbs dust/ton of iron poured to 17.80 lbs dust/ton of iron poured. Rate of cupola operation, as would be expected, had a marked effect on cupola emission performance. As an example, a size No. 9½ cupola operating at approximately the same melting rate (16.5 ton/hour) and at an iron to coke ratio of 8.0 to 1, gave stack emission rates of almost 30.0 lbs dust/ton of iron poured.

Other factors such as the cupola charging method and the cupola charge material will materially affect emission rates. Machine-cast pig iron and shot blasted scrap iron used in conjunction with large-sized coke which is not susceptible to excessive fractionation have helped this plant and other plants to reduce cupola emission. We find that there is no acceptable or accurate substitute for assessing an air pollution problem or the effectiveness of the control apparatus, short of detailed stack emission testing.

Figure 1 shows a wet cap type cupola collection system that has found some acceptance in the industry. Such systems, while quite effective in collecting the large size particulates and in reducing the fire-hazard problem caused by emitted burning cinders, do not exhibit the high percentage collection efficiencies required to perform within the ASME recommended limitations on dust emission.

Dry Centrifugal Collector

Figure 3 shows a cupola collection system embodying a high efficiency dry centrifugal separator being tested for air pollution performance. A well designed system of this type can effectively reduce cupola emissions to comply with most air pollution ordinances. On some of the larger cupola installations, electrostatic precipitators have been installed follow-

ing a dry type gravimetric or centrifugal separator system. Glass bag filter systems following a temperature reducing device have also been used on this application. We have had the occasion to assess the

TABLE IV—SUMMARY OF DUSTLOADING EMISSION RATE TESTS ON A 3.0 TON STEEL ELECTRIC MELTING FURNACE*

Test No.	CONDITIONS	EXIT DUSTLOADINGS				
		Volumetric Basis				Weight Basis
		Grains/Ft.³		Sampling Conditions		#Dust/ 1000# Flue Gas
		Actual	SCTP**	Temp.°F	Press. in. Hg.	
1	First 38 minutes of melt.	0.236	0.284	120	29.31	0.502
2	Last 41 minutes of melt including 0_2 decarburization.	0.400	0.486	139	29.30	0.876

*Data from actual field tests conducted by the author.
**SCTP—32°F, 29.92 In. Hg.

effectiveness of a high draft loss wet collector system on this application and found it to have a high collection efficiency. Unfortunately, such control systems would be prohibitive from a cost standpoint for most of the small foundry operators.

Electric Melting Furnace Dust Control

Unlike a cupola emission, steel furnace particulates are extremely small. Most such particles, on a weight or count basis, are in sub-sieve ranges. Net result is that electric melting furnace discharges are much more visible and apparent than cupola discharges.

On a weight basis, an electric melting furnace discharge will be in the range of from 5 lbs to 8 lbs dust/ton of steel poured. Table IV, a summary of dustloading emission rate tests on a 3 ton steel electric melting furnace, illustrates the extent of the steel furnace emission problem.

Because of the small particle sizes involved, dispersion of dust and metallic fumes will be over a much wider area than for cupola or air melting furnaces. The high discoloring power of the predominantly iron oxide fumes will quite likely create nuisance conditions over a much wider area than the cupola or air melting furnace discharges.

Figure 4 shows a dacron bag collector installed on the exhaust of an electric melting furnace. This is the same plant depicted in Figure 5 and represents a "before and after" situation. This particular collector handles a 12,300 cfm gas volume with an average inlet grain loading of 0.40 grains/ft. 3 at 139 F and 29.30 in. mercury. The discharge of this unit is virtually clear as a collection efficiency of 97 percent to 98 percent is achieved. This unit has been in operation for approximately three years and has given excellent performance with a minimum of maintenance. After the orlon bags originally supplied with the unit were replaced after nine months of operation, the 528 dacron bags presently in use have had to be replaced only on an average of four bags every three months.

Fig. 5: Dacron bag collector on electric furnace. This is same collector as shown in Fig. 4, representing a before and after condition. Emission tests are in progress near smoke stack.

Many and varied types of wet collection systems are presently installed on electric melting furnace emission problems. We have yet to find any of these installations perform as efficiently and as maintenance-free as the dacron bag collector system. Recent improvements in fabric tube construction have made it possible to utilize the high flow continuous cleaning bag type filter systems on this application. This should result in reduced space requirements and reduced initial cost for such a system on the electric furnace fume problem.

Remaining Control Problems

In the last ten years the metal working industry has made great strides in the reduction and control of its air pollution problems. However, many emission problems remain only partially solved. Lower cost, high efficiency cupola and electric melting furnace control systems are a serious need. An alternative solution to the cupola problem would be the development of a closed cupola charging and control system,

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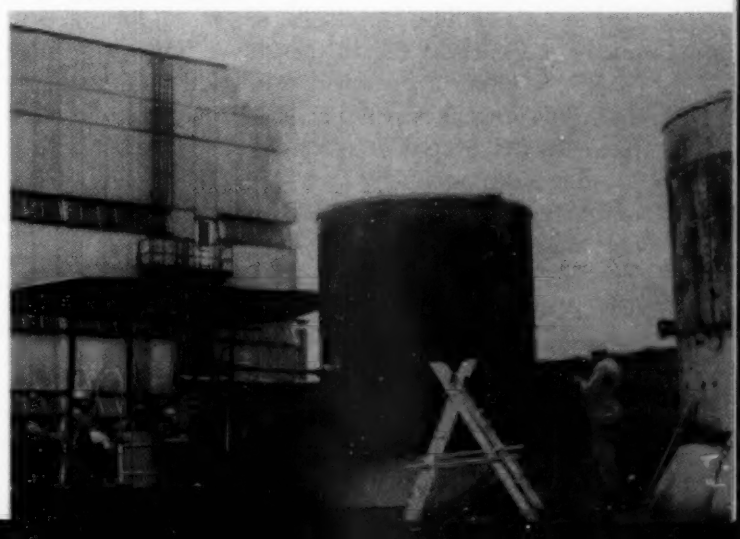
Fig. 6: The author and an inspector, both of Milwaukee County air pollution control department, are shown conducting stack emission studies on one of some 100 gray iron cupolas in area.



by W. O. Huebner
Technical Editor
Anemostat Corporation of America

How Esso Cuts Flare Gas Losses

New way to measure, record and control industrial gases helps Esso reduce flare gas loss, and find flare gas leaks quickly.

Flare gas losses at Esso Standard Oil Company's Bayonne, N. J. refinery have been reduced by accurate control of waste gas flow from cracking units . . . fast leak detection in flare gas laterals. The company has obtained an 85 percent reduction of product loss caused by flare gas. And by accurate measurement of gas flow in the main flare gas stack, steam flow can now be quickly regulated to reduce stack smoke emission.

Until the introduction of a new gas flow meter, the problem had been one of accurate gas flow control and measurement, complicated by the fact that leaks in flare gas laterals were hard to isolate without shutting down cracking units. Gas flow measurement had to be made without causing an appreciable drop in line pressure to assure proper operation of constant back-pressure relief valves.

Here's How Esso Solved Flare Gas Problem

The flare-smoke reduction program at Bayway is part of the Esso Company's general anti-pollution program, and its success is due to the efforts of the Conservation Control Division of the company. The program of the Division has three objectives:

1. *To reduce emergency flaring* by providing better instrumentation and training of operators, by transmitting gases to a gas-recovery unit, and by tailoring unit operations to fit emergency situations.

Better instrumentation prevents faulty operation of equipment, better training of operators, reduces the number of unit upsets, or in case of emergency, makes it easier to regain control of the faulty unit.

2. *To prevent "planned flaring"* during start-ups and shut-downs. Operators are expected to control the emission of potential flare-gases by careful pre-planning; consequently, flare gases result mainly from unit-leaks into the flare-line laterals or from process-unit upsets.

3. *To stop leaks in equipment* connected to the flare system as rapidly as possible. Equipment which is found to be leaking excessively into the flare system, is taken off-stream in order to be repaired at once.

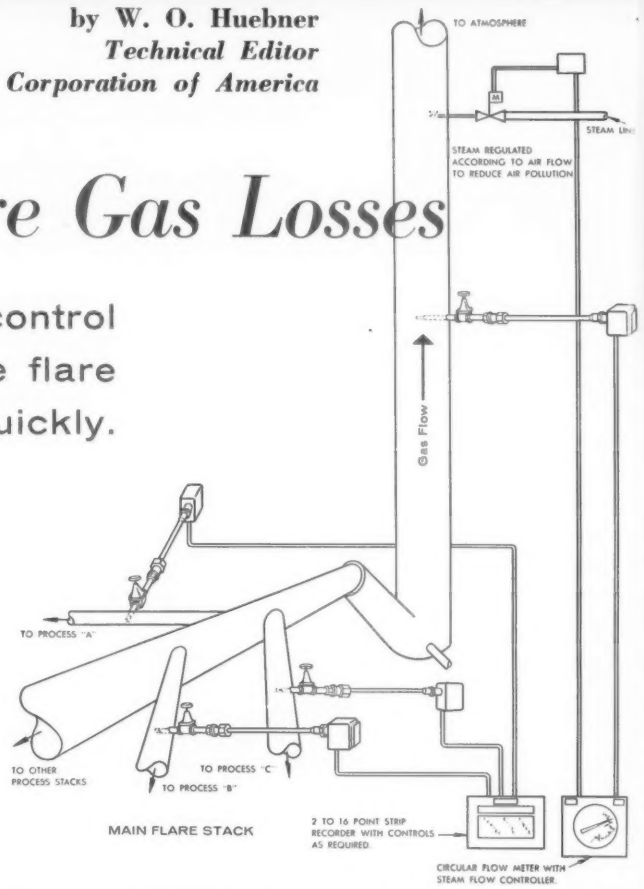

TO ATMOSPHERE
STEAM REGULATED ACCORDING TO AIR FLOW TO REDUCE AIR POLLUTION
STEAM LINE
Gas Flow
TO PROCESS "A"
TO OTHER PROCESS STACKS
TO PROCESS "C"
TO PROCESS "B"
MAIN FLARE STACK
2 TO 16 POINT STRIP RECORDER WITH CONTROLS AS REQUIRED.
CIRCULAR FLOW METER WITH STEAM FLOW CONTROLLER.

Fig. 1. Oil refinery flare line laterals feed into single stack, make it difficult to find leaks without shutdowns. Instrumentation for checking gas-flow is the answer.

To discover leaks without proper instrumentation is quite difficult, however, and it is for finding leaks without delay that a new gas flow meter has been developed by Anemostat Corporation in collaboration with the Conservation Control Division of Esso.

Dozens of flare-line laterals feed into one main flare-stack, as shown in Figure 1, and unless a leak is either visible or audible, it is very difficult to find the leaking unit. Before proper instrumentation was available, Esso used for several years the technique of "planned shut-down" in order to find leaks.

However, this way of detecting leaks into flare lines leaves much to be desired. Often several shut-downs, with the equipment being off-stream for several hours, may be necessary, before the offending unit can be found. And if the correct unit has been located, it may be necessary to keep the unit off-stream for an hour or longer before the effect of the shut-downs shows in the amount of flaring. Also, instability in other units feeding the same flare-stack may result in misleading information.

Accurate Leak Check

Until recently, refineries using constant back-pressure type relief valves (as Bayway does), had no satisfactory way of metering gases flowing through flare-gas lines. The use of displacement type gas meters was not possible, because the relief valves

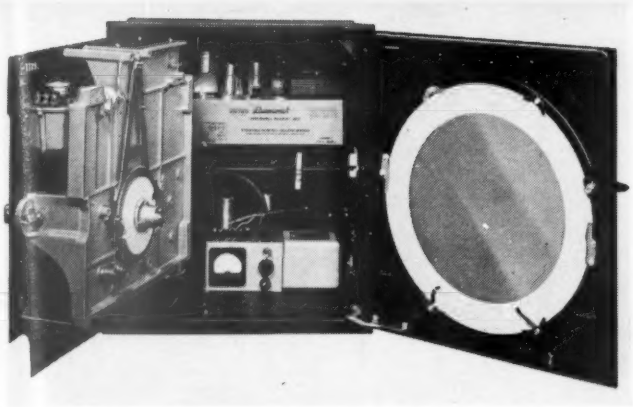


Fig. 2. Leaks in flare lines, stacks, gas flow velocities in wide range of chemical and process industries can be recorded and measured by gas flow meter above.

operate properly and safely only if there is no appreciable pressure drop in the flare-gas lines. Before introducing the new gas flow meter, the Conservation Control Division therefore was limited to rough estimates of flare-gas quantities. The use of the new Gas Flow Meter permits accurate gas flow measurements and process control, and therefore effectively reduces flaring losses.

Other Uses of the Instrument

By measuring gas flow through a wide range of velocities, the new instrument can be used to improve process control in many industries with important savings in money and manpower.

In chemical plants the instrument can be used for effective control of various gaseous processes; a change in flow measured by the instrument can be used to actuate a control device. In a similar manner, gas flow in transmission lines can be kept constant. Also, the settling-time required for vat-waste disposal processes can be reduced by carefully checking the gas-flow discharge-rate.

There are many other applications of the instrument possible. For instance, it can be used to control air flow in the ice cream rooms of dairies, the ventilation of large transformers in power stations, and the air flow above looms in textile mills. Finally, the efficiency of furnaces, boilers and heat treating equipment in industrial plants generally can be improved by the use of the instrument.

At Esso, careful supervision of the gas-flow rate reduces the amount of waste gases, saves steam for flare-stacks, and improves air pollution control.

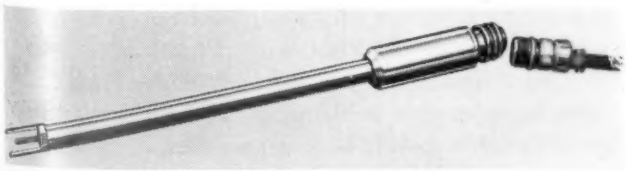


Fig. 3. Probe element for insertion in gas stream for measuring velocity, temperature. Strip chart, not shown, can record up to 16 flows.

The new probe-type gas flow meter developed by Anemostat and Esso is used for measuring, recording and controlling gas flow in the flare-stacks of oil refineries as well as for other air or gas flow in many other processes, as noted above.

The equipment required for measuring, recording and controlling air or gas flow is shown in Figure 2 (Anemotherm Gas Flow Meter) and Figure 3 (Power Meter Unit installed in Recorder).

1. The gas flow meter is a probe-type instrument. The sensing element is basically a heat loss anemometer of special construction for use in process industries.

2. The power meter unit is a special step-down transformer-rectifier unit developed by Anemostat for use with the gas flow meter.

3. The pneumatic or electric recorder is a standard recorder as manufactured by several instrument companies, modified for the resistance bridge circuit of the gas flow meter. Either circular or strip recording charts are used.

How the Gas Flow Meter Functions

Air flow can be read directly from the instrument chart and scale. When the flow of a gas other than air is being measured, the instrument reading must be corrected for specific heat and density factors.

When rate of gas or air flow over the probe varies, the heat loss of the heated element of the probe varies and causes an unbalance of the bridge circuit. The unbalance of the bridge circuit causes the recorder to actuate its balancing motor which drives the slide-wire contactor and associated indicating, recording and controlling mechanisms until the circuit is restored to a balanced condition.

Special Features of the Gas Flow Meter

Because of the extremely low mass of the sensing windings, the sensing probe responds very quickly to changes in the variable.

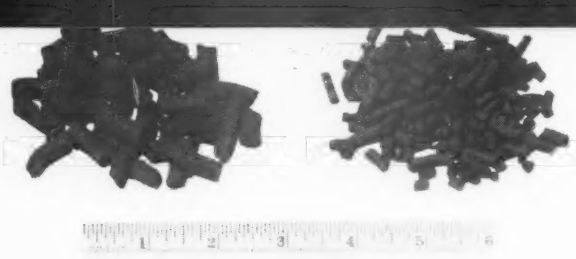
The electric potentials at the sensing element are low, and the temperature of the heated element is only 20 F above the ambient gas temperature. Therefore, there is practically no hazard in inflammable atmospheres, and the probe can be used in any gas.

The measuring circuit is self-compensating for ambient temperatures up to 300 F because the exposed probe elements (heated and unheated) are of the same material and resistance.

The chart and scale reads 0.1 to 50 with multiplying factors from 100 to 300 to provide a range calibration from 10 to 15,000 fpm. Accuracy is 1½ percent of the instrument reading.

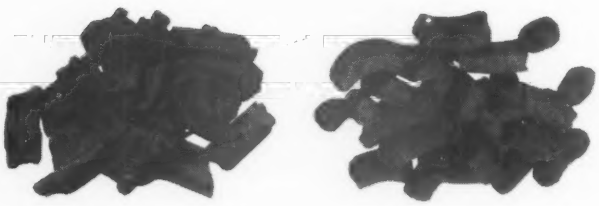
The strip chart instrument can record up to 16 different flows on a single chart.

The new instrument has other applications for measuring, recording and controlling the rate of flow of many industrial gases, without obstructing gas flow itself.

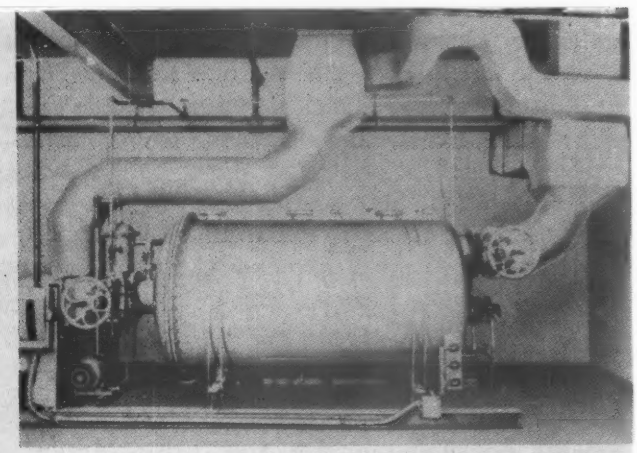


Left: Large AC pellets and granules permit high air velocities and economical adsorber proportions.

How Activated Charcoal

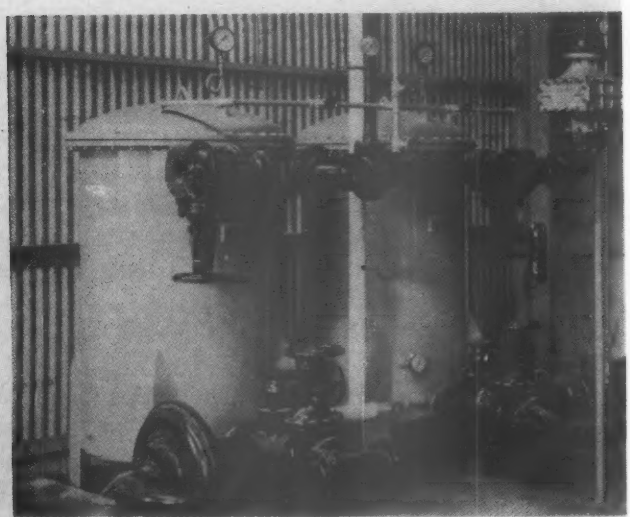


by Joe H. English
Consulting Engineer
Abilene, Texas



Single adsorber purifies during day, desorbs at night. Air is returned for reuse.

Below: By using a pair of adsorbers, operation can be continuous.



Charcoal from coconut shell traps 170 times own volume in odors . . . adsorbs odors, fumes, noxious gases, radioactive vapors, makes "used" air fresh as a day in June, cuts heating-cooling bills 30% or more.

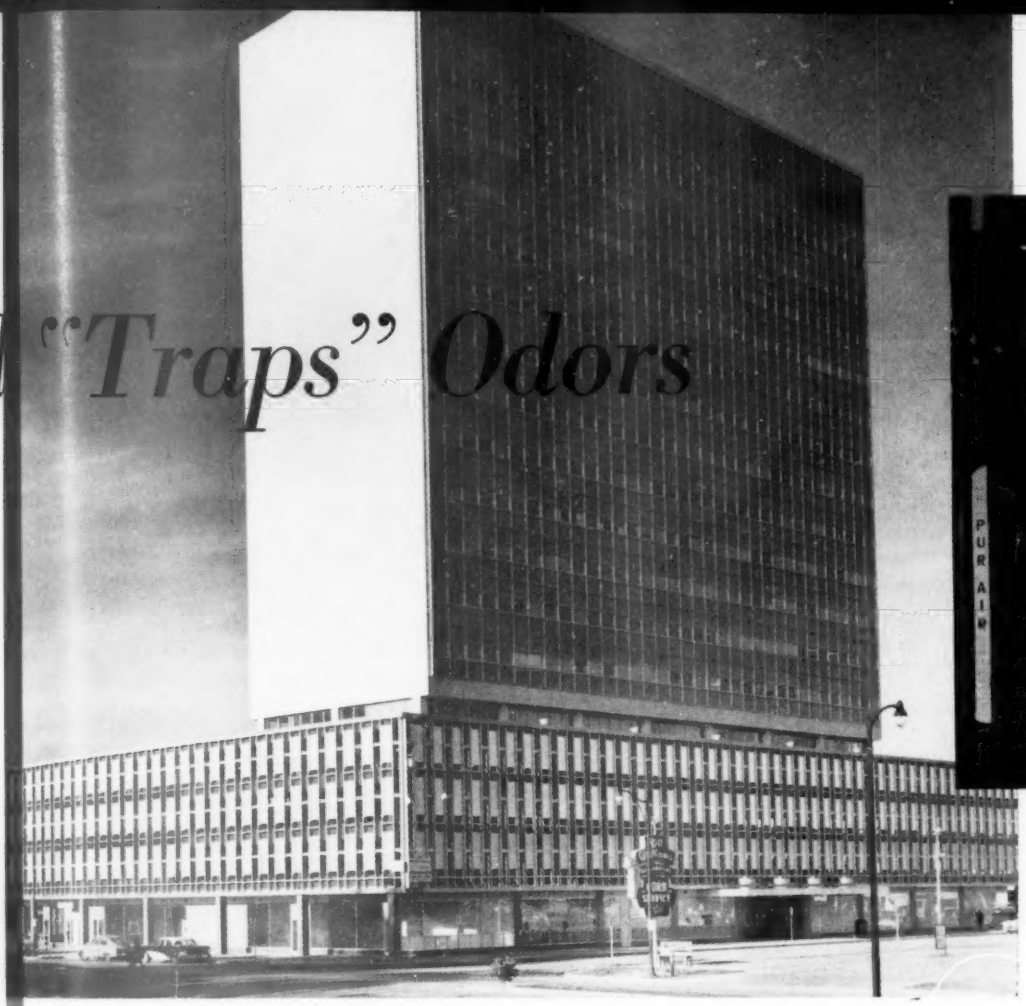
A substance so odor thirsty that it will adsorb 170 times its own volume of ammonia gas—fantastic! Yes, but the charred ashes of the coconut shell are truly fantastic in many ways . . . when it comes to trapping odors and noxious gases.

Odor is an elusive property of air. To capture it, activated charcoal literally traps odoriferous vapor or gas molecules in its millions of tiny surface pockets. Only one pound of activated charcoal, before becoming saturated, will adsorb all of the pungent odor emitted when dozens of bushels of onions are peeled. This same pound of material, after reactivation, could then adsorb all of the odor from 64 dram bottles of strong perfume. Coconut shell activated charcoal is odor voracious.

Complete Odor Removal Necessary

To produce a distinct odor sensation, very little substance is necessary, often less than one part per one million parts of air. To be effective, odor removal must be thoroughly complete. For instance, if an odor is overpowering, a 99 percent removal still leaves a distinct odor; and a 99.9 percent removal would still leave an odor that is barely perceptible. This odor-thirsty material, activated charcoal, is the only one known that will totally remove odors, even though they are barely perceptible. All types of odors are

"Traps" Odors



Building, Houston, Texas, activated charcoal filter banks purify 30% of the recirculated air to cut cooling costs.

Activated charcoal cells are installed in new cell bank, can be easily removed for reactivation.

susceptible, even stale cigarette smoke and onions.

As a catalyst, activated charcoal is the most potent known. Its surface is covered with millions of minute tubes so small they are invisible even under a microscope. One pound of activated charcoal has over six million square feet of surface. The molecules of practically all vaporous and gaseous impurities in the air are adsorbed by these tubes in about 1/30th of a second, leaving the air odor-free.

Before needing reactivation, one pound of activated charcoal will soak up about one-half pound of odors. This is more than the average person inhales in a lifetime. For you to smell a substance, it must give off vapors.

Other Methods of Odor Removal

Once these vapors are mixed with the air they do not settle out, but activated charcoal will remove them. Odors are very elusive. One method of combating odors is to mask the undesirable odor with a more pleasant one. Another method is dilution by inducing odor-free outdoor air in with the air of an occupied space. The masking method can be dangerous with irritating or toxic matter. It sometimes only desensitizes the olfactory nerves. Caution should be observed, for instance, in the use of ozone for fighting odors. Completely removing the odor is the activated charcoal way of ridding air of unpleasant smell.

The dilution method is usually expensive – especially whenever the indoor air has been conditioned by mechanical means. Very little outdoor air is required for maintaining ample oxygen in occupied spaces. The amount of oxygen in such places seldom drops more than one-half of one percent. Normal air has about 21 percent oxygen, and a shortage cannot be detected by the average person until the percentage drops to less than 15 percent. This would only occur in an absolutely tight location such as in a refrigerator, vault, or submarine.

"Stuffiness" is often attributed to the lack of oxygen in the air, but this is caused by odors and impure air. Our men in the submarine service never breathe anything but pure air. This critical fresh air problem is solved – thanks to activated charcoal. Submarine air is more like that on top of a mountain early some spring morning.

Substantial Savings

By correctly using charcoal filters in the air conditioning system, substantial savings can be realized by the owner. In Richfield, Minn., the Assumption Parish School saved $12,000.00 in installation costs of

(Please turn to following page)

(Continued from preceding page)

their system, and another $1,650.00 annually in operating costs. This was possible only because the use of activated charcoal makes it unnecessary to bring in a large amount of outside air just to minimize odors. Much greater savings were made in the New York Criminal Courts Building. They installed 250 tons less of cooling and ten million Btu less of heating equipment because most of the air would be recirculated. This means less power requirements – to the tune of 300,000 kwhr and 200,000 gallons of fuel oil annually.

Similar installations include the Dallas Civic Auditorium; St. Vincent's Hospital, Los Angeles; Medical Towers, Houston; California Teacher's Association, Los Angeles; and Mount Carmel Hospital, Columbus, Ohio. Up to 30 percent savings are made by not having to cool or heat outdoor air for ventilation. Smaller buildings are enjoying proportionate savings. Toxic sulfurous and phosphorous vapors are prevalent in city air but are absent from the air in a building using activated charcoal filters in the air conditioning and heating system.

A business that merchandises only cloth fabrics solved a very serious problem with activated charcoal. Whenever a large shipment of synthetic materials arrived an eye-burning, irritating atmosphere would prevail and make conditions unbearable. Such shipment arrivals now go unnoticed due to the air cleansing of activated charcoal.

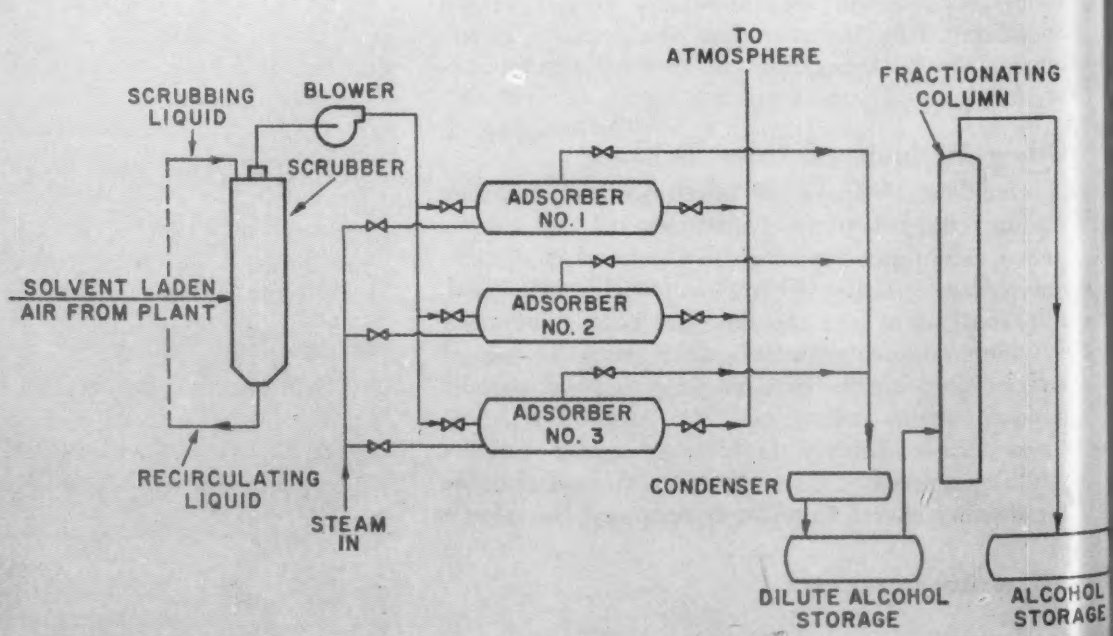
Activated charcoal is presently essential to many precision instruments. Without activated charcoal, delicate electrical contacts would become tarnished; but activated charcoal removes these sources of tarnish that would likely cause a malfunction of very expensive tests. Prolonged submersions by atomic-powered submarines are possible due to activated charcoal air recovery.

Laminated plastic installation with scrubbers in foreground.

How To Figure Ventilation Needs

The simplest method of figuring how to ventilate a space by recirculation and activated charcoal is to determine from tables in the ASHAE Guide how much outside air is recommended for ventilating the particular type of occupancy. Recirculate this amount of air and purify it by activated charcoal. In this manner the same amount of odor-free air will be available for ventilation. If it is desired to improve on the condition recommended by the Guide, use a larger quantity of charcoal-purified recirculated air.

There are many ways to determine the quantity of activated charcoal required per year to handle a specific air purification job. Here are two practical methods for design of these systems.



Waste gases from the manufacture of laminated plastics are scrubbed with caustic soda and adsorbed by AC. Alcohol is recovered for reuse.

Pounds of Activated Coconut Shell Charcoal Required Per Year

Residences	
Total per person, non-smoking	1
smoking	2
Individual rooms per person	
Living room	.5
Dining room	.25
Kitchen	.25
Toilet and bath	.25
Bedroom	.15
Laundry	.15
Office	
Total per person, non-smoking	1
smoking	2
Hotel, per person, average occupancy	2
School, per pupil	1.5
Hospital (room or ward), per bed	3
Laboratory (average), per person	3
Bar or tavern, per occupant	5

Add up the pounds of activated charcoal needed as indicated in the table. For example, if we have six people in an office, three of whom are smokers, and three non-smokers, we need a total of 9 pounds for one year's service under average conditions. If the purification cell used contains 18 lbs the life will be two years before recharging.

Odor Level Guide

The relative odor levels in various types of locations are listed in the following table as A, B, C, or D. Locations A contain the lowest amount of odor and D the highest. B and C represent levels in between. In typical cases, one pound of 50 minute activated coconut shell charcoal will purify the following amount of space for one year – A – 2,000, B – 800, C – 300, and D – 100 cu. ft.

Odor Index for Type of Space
(Condensed Table)

C – Aircraft	B – Hotels
D – Air raid shelters	C – Kitchens
D – Animal rooms	C – Locker rooms
A – Apartment buildings	D – Meat packing plants
C – Apple storage	C – Morgues
B – Auditoriums	B – Offices
C – Bars	C – Photo dark rooms
C – Beauty shops	D – Pollution control
A – Churches	C – Public toilets
C – Conference rooms	C – Recreation rooms
B – Department stores	B – Restaurants
C – Drug stores	C – Schools
D – Funeral homes	B – Super markets
A – Homes	C – Telephone exchanges
C – Hospitals	B – Theaters

A standard air purification cell contains 45 pounds of activated charcoal and purifies 1,000 cfm of air.

Cells are installed in filter bank, downstream from dust filter system.

This amount of air corresponds to 3 to 5 tons of refrigeration, depending on the section of the country. The cell costs a contractor about $125.00. He will probably spend an equal amount per cell to install it in the ventilating system. This means an initial cost of $250.00 per 1,000 cfm of recirculated air. For cooling 1,000 cfm of outside air, 3 to 5 tons of refrigeration is required, costing $200.00 to $1,000.00 per ton, depending on the individual job and what is included. Taking the low figures, we have a savings of $600.00 in initial equipment for an expenditure of $250.00.

It costs roughly $30.00 to $36.00 per recharge per cell, depending on location, and this is done once per year in a typical case. This means $2.50 to $3.00 per month. The cost per month for power for 3 to 5 tons of refrigeration is many times this figure. Similar cost savings figures can be prepared for the heating season.

On an overall yearly basis, depending on the type of occupancy and the quality of indoor air desired, the use of recirculation and activated charcoal will show savings of from 10 to 60 percent in the initial cost of heating and cooling equipment and in operating cost for heat and power. Charcoal filters provide the logical answer to the elimination of odors, toxic vapors, and smog from ventilating air for living and working spaces.

The lowly coconut has always been a good provider, but now it is becoming indispensable to our way of life.

Large installations, as shown below, use batteries of activated charcoal adsorbers. Values recovered may pay for the treatment . . . even yield a profit.

A Report on Precipitator Applications

by V. W. Copcutt

Director of Marketing
Research-Cottrell, Inc.

A summary of recent industrial applications of precipitators for process improvement, material recovery, air pollution control in the chemical field.

A widespread and growing use of industrial type precipitators in the chemical industry is based on both the economic factor, wherein the equipment improves efficiency in production and processing operations; and in the area of community relations, through the prevention and abatement of possible nuisances resulting from chemical plant operations.

The precipitator in a chemical application may be used for: (a) Recovering a valuable material such as carbon black, sulfuric and phosphoric acid, sodium salts, and oil refinery catalyst, (b) cleaning air or gas for subsequent use, such as in contact sulfuric acid plants where the SO_2 gas must be free of dust and acid before it enters the converters, or in limestone plants where CO_2 is used for carbonation, (c) preventing a nuisance and building good community relations such as by removing acid mist from concentrator gases or cement dust from cement kiln gases, (d) a combination of these purposes.

A recent tabulation of precipitator capacity in the chemical industry placed the total at approximately 500 precipitators with nine million cfm capacity. The precipitator applications the grouping represents include the following: sulfuric acid, asphalt stills, gypsum, phosphorous, oil shale, cat cracker.

Add to these carbon black, paper mill and cement applications, and total is increased to 975 precipitators and 61.6 million cfm by following additions:

Type	*No. of Precipitators*	*Millions Cfm*
Cement	225	30.4
Paper Mill	167	18.9
Carbon Black	83	3.3

Typical one-day collections by precipitator installations (one or more precipitators per installation) include the following:

- 2 tons of sulfuric acid mist per calciner
- 50 tons of carbon black per bank of furnaces
- 100 tons of fluid catalyst per regenerator
- 50 tons of sodium salt (sulfate) per kraft mill recovery furnace
- 12 tons of gypsum dust per kettle
- 50 tons of cement dust per kiln

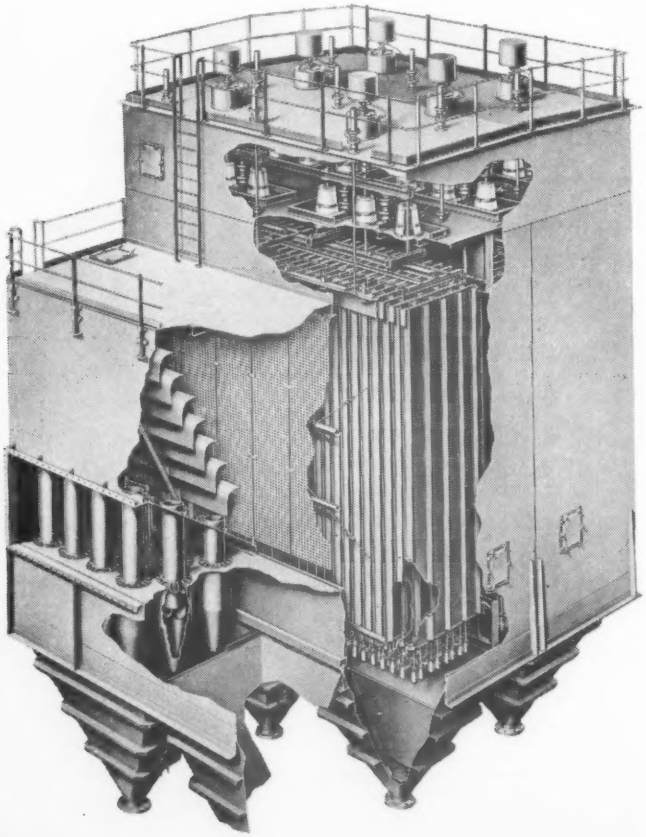


Plate type precipitator in combination with a mechanical collector. This arrangement is used in cement kiln dust collection, eliminating nuisance air pollution.

This pipe type precipitator is used in production of acids. The unit removes acid mists, cleans tail gases from sulfuric acid concentrators, contact processes.

There are two basic types of precipitators. In the *pipe type,* used mostly for removing liquid or sludge particles and volatilized fumes, a number of collecting electrode pipes are grouped in a single shell under a header plate and the discharge electrodes are suspended through the centers of the electrodes, one to a pipe.

In the *plate type,* used primarily for removing dry dusts, groups of collecting electrode plates are suspended in parallel to form gas passages or ducts, and the discharge electrodes are suspended in rows centered in the ducts.

Application In Sulfuric Acid Production

In manufacturing sulfuric acid by the contact process the gases, before entering the drying tower and after the scrubber, are generally treated in precipitators for the removal of acid mist. Since small traces of acid mist are detrimental to the function of the catalyst, it is necessary to obtain extremely high efficiencies.

In chamber acid plants, particularly where metallic by-product gas is used, the gases are treated at high temperatures for dry dust removal before they enter the glover tower. Two important applications have been made in the sulfuric acid industry for preventing atmospheric pollution: 1. cleaning tail gases from sulfuric acid contact processes, 2. cleaning tail gases from sulfuric acid concentrators.

Economies In Making Phosphorous

In manufacturing phosphorous by the electric furnace method it is universal practice to treat the hot furnace gases to remove suspended dust before the elemental phosphorous is condensed. This results in a very economical production of a pure phosphorous. Precipitators also remove phosphoric acid when phosphorous is oxidized and hydrated.

Asphalt, Gypsum and Oil Shale

Precipitators are used on the blowing stills in the chemical treatment of asphalt. Gases from gypsum kettles, dryers and calciners are treated economically in precipitators.

Removing tars from oil shale distillation gases is a relatively new application, where the gases cleaned in the precipitator are subsequently condensed and treated to produce petrochemical products.

Vital for High Octane Gasoline

An application in the oil industry which played a large part in the war production of high octane gasoline is the use of precipitators for recovering catalyst in the cat cracker installations. In the fluid catalytic cracking process, oil and powdered catalyst are brought together in a reactor to cause the desired cracking. In the reaction, carbon forms on the catalyst and reduces its efficiency.

The spent catalyst is then sent to a regenerator, where the carbon is burned off and the regenerated catalyst returned to the reaction system. The regenerator flue gas, carrying large amounts of entrained catalyst dust, is passed through cyclone separators, then cooled to 400 F to 600 F and finally passed through the precipitator.

Electrical precipitators have been used for the removal of dusts from cement kiln gases for many years. They have also been used for collecting dust from stone dryer and combustion gases, from the

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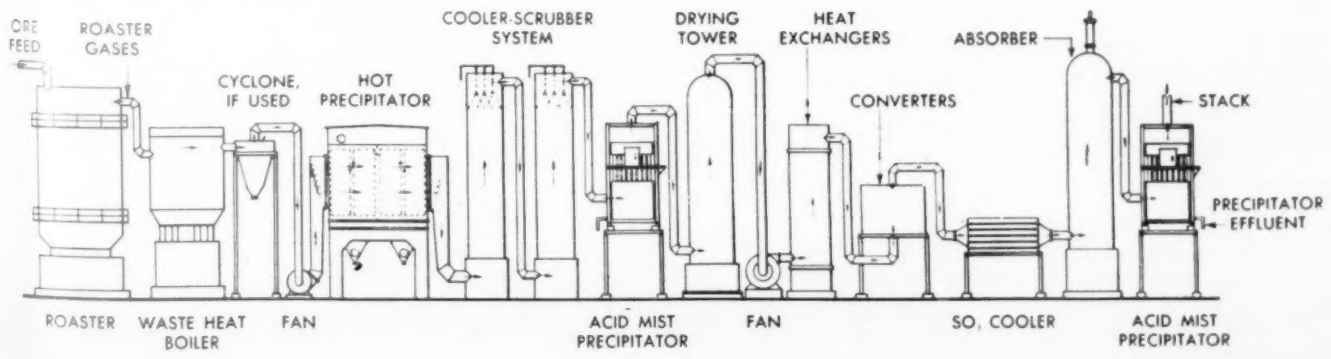
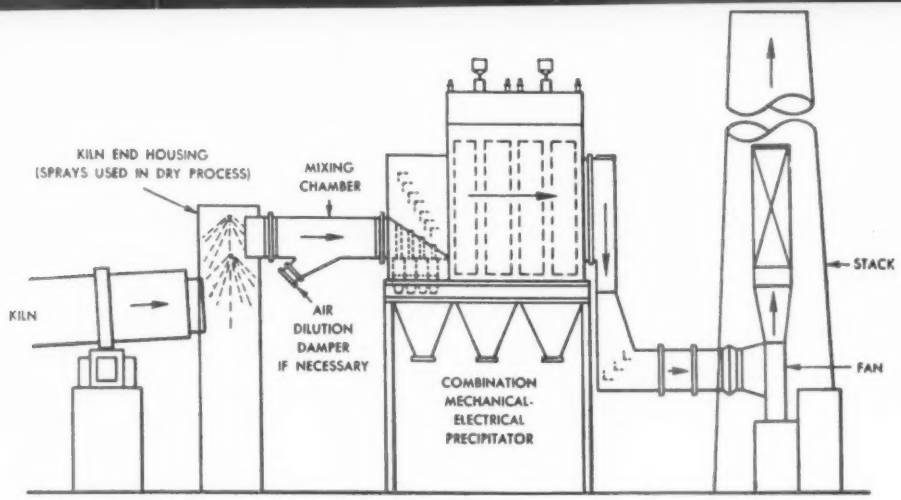
Flow diagram shows precipitator application in production of sulfuric acid. Note location of precipitator on-stream between scrubbers and drying tower.





Flow chart at right shows cement kiln dust collection application.

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ventilating air of finish mills and auxiliary equipment, and after Fuller-Humboldt preheaters.

In the rotary kiln application, waste gases are discharged at 400 F to 600 F for a wet process kiln and 1000 F to 1600 F for a dry process kiln, and carry suspended particles usually in the range of 4 to 10 gr/cu. ft. with some cases up to 20 to 40 gr/cu. ft. Raw material consisting basically of lime and clay materials is charged to the kiln as a fine powder carried by air for dry process or by a water slurry for wet process. In the case of dry process kilns, the gas temperature is reduced to 600 F to 700 F before precipitation. This may be done by means of radiation cooling, air dilution, or spray cooling.

Important In Paper Mill Operations

In the sulfate and soda processes of alkaline pulping, the problem involves cleaning gases resulting from the thermal decomposition of organic chemicals in the recovery furnace. After leaving the furnace, the gas passes through an evaporator where it is cooled to about 300 F before entering the precipitator.

In the precipitator, the gas is subjected to electrostatic treatment to remove most of the solid particles, consisting mainly of sodium sulfate in kraft mills and of sodium carbonate in soda plants. Cleaned gas is exhausted through a stack to atmosphere.

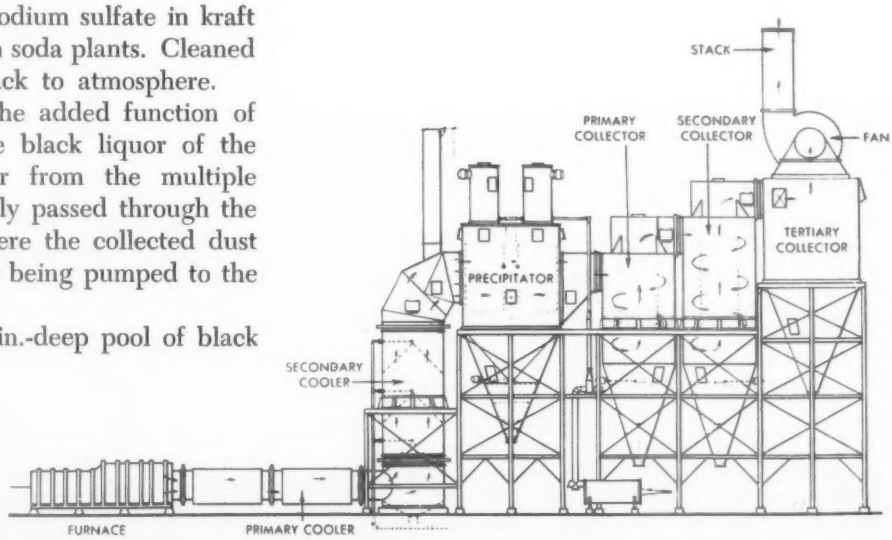
The precipitator performs the added function of mixing collected dust with the black liquor of the recovery system. Black liquor from the multiple effect evaporators is continuously passed through the bottom of the precipitator, where the collected dust is mixed with the liquor before being pumped to the cascade evaporator.

During the operation, a 12-in.-deep pool of black liquor is maintained in the wet bottom by automatic level control, and the collected salt cake drops into this pool during rapping of the electrodes. A horizontally operated agitator is rotated through the pool to insure proper mixing of the dust with the liquor. Thus the precipitator wet bottom provides a most satisfactory means of returning collected dust to the recovery system operation.

Has Role In Carbon Black Production

Much of the carbon black used as a reinforcing agent in making synthetic rubber is produced by burning natural gas under controlled conditions in special furnaces. In this application, the precipitator collects some of the resultant carbon particles and agglomerates the others so that the agglomerates can be recovered in special cyclone collectors following the precipitator.

The carbon particles leaving the furnaces are extremely fine and, under the influence of the electric field, they combine to form small clusters easily collected in relatively low velocity cyclones. If necessary, a special wet scrubber precipitator can be used to remove the small amount of black remaining in the gases after they pass through the cyclones.



In carbon black production, precipitator clusters very fine carbon particles for collection in cyclone.

A Car "Burning Problem" Solved

No more open yard burning of junk car bodies may be answer to this smoke nuisance. Here is one way to burn car bodies smokelessly.

Fig. 1: Car burner in New York City can burn 120 cars per day without creating smoke and odor nuisance. Car enters burning chamber, where it is automatically ignited.

Open yard burning of junk car bodies has long been a nuisance to those living in the immediate vicinity of the yard area, as well as a potent source of complaint to air pollution control officials. Open yard burning means that the operator, after stripping one to a dozen cars, douses the pile with fuel oil or gasoline, tosses a match and steps back to await completion of this uncontrolled incineration.

Meanwhile, clouds of dense, black, odorous smoke roll upward from the burning car bodies, pungent with a nose twitching mixture of burnt rubber, paint, plastics, upholstery, undercoating and greases.

Open Yard Burning Banned

In the New York City area alone over 200,000 cars were thus "burned" annually, according to Dr. Leonard Greenburg, Air Pollution Control Department Commissioner. This burning was banned by New York City last December 31, 1958. Report has it that many other cities, after inspection of a new, smokeless car burner in New York, will follow suit and forbid open car burners.

The new car burner, known as a "Smokatron" was developed and fabricated in Columbus, Ohio and shipped to New York by rail. The entire unit weighs 550,000 lbs and is capable of burning over 15 cars per hour—120 or more in an eight hour day. It has a tunnel-like burning chamber (Figures 1 and 2), is 120 ft. long, with a 30 ft. loading and discharge platform at either end.

A double chain conveyor runs the full length of the burning chamber. Each car is mounted on carrier cradles, or flights, and is drawn through the burning chamber, as shown in Figure 1. Cars are automatically ignited as they enter, and quenched with water sprays as they leave the discharge end (Figure 2) completely burned out and ready to be pressed and baled for transportation to steel mills.

Heart of the Smokatron is an electrical precipitator contained in two 40 ft. high towers, which straddle the burning chamber. Figure 3 shows the towers. When current is turned on in the precipitator an intense electrical field is created between an electrode wire in the center of 144 six-in. pipes and in the pipes themselves.

Smoke from burning auto bodies passes through this intense field. Carbon particles in the smoke are charged and collected in pipe walls, washed down pipes at the end of the day by a built-in water spray. According to Harold T. Smith, Chief Engineer of Summer & Company, Columbus, Ohio, developers of the Smokatron, the precipitator removes particles as small as a few millionths of an inch. Odor is reduced below the objectionable level and smoke, soot and flyash are eliminated.

(Please turn to next page)

Fig. 2: As burned out car leaves burning chamber, it is doused with water for quick cooling. Car is now ready to be pressed and baled.

Fig. 3: Before precipitators are turned on, towers emit smoke as shown at right.

(Continued from preceding page)

Consulting engineers, air pollution control officers, scrap iron dealers, plant engineers concerned with similar "burning" problems, may at this point find several questions as yet unanswered in this article. Here are a few questions that have already occurred to one air pollution control official, with their answers:

Questions and Answers

Question: What are manpower requirements for the Smokatron compared with previous method of burning cars?

Answer: No increase in manpower is required. No special training is needed. The same operator who ignited a large stack of gasoline-soaked cars in a field can operate the unit.

Question: Any problems with regard to smoke from undercoatings, or zinc or copper recovery?

Answer: None, since smoke from undercoating is captured in the precipitator. Copper is usually removed by scrap dealer. Zinc or lead melts, drips off cars in the burning chamber, where it is reclaimed.

Question: What thoroughness of stripping is required?

Answer: That's up to the operator, is no different than for any other car burning operation. Normally tires, engine block, pistons, radio, radiator and other non-ferrous materials are removed by the operator.

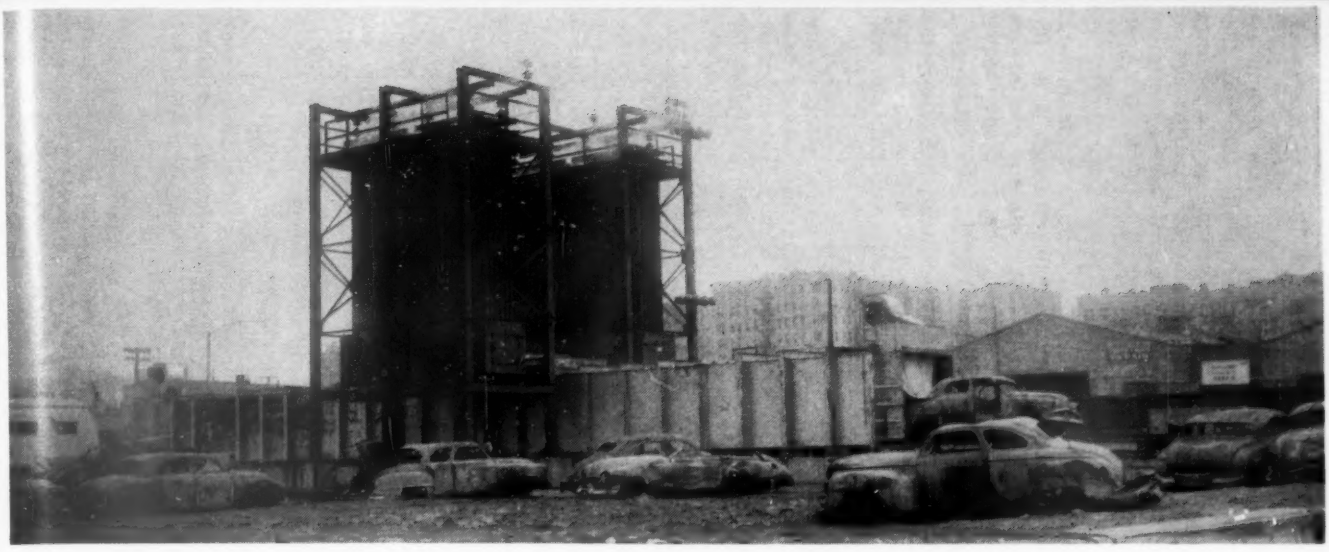
Question: If water spray coolant is used, any fumes liberated? If so, how controlled?

Answer: No fumes are liberated by the water spray. Some steam does emanate, harmlessly, from top of tubes. Water spray does two things: 1. Conditions smoke by wetting smoke particles, enables them more readily to take an electric charge. 2. Acts as a washing agent to sluice down inner walls of precipitator tubes.

Fig. 4: With precipitators on, car burning proceeds without creating smoke or odor. Smoke particles are captured by precipitator, washed down unit with water spray.

Question: Any auxiliary fuel used? If so, what kind? Any problems with gasoline or oil in cars?

Answer: About one gal of fuel oil per car, at 14¢ per car, is used for igniting purposes.



General view of car burner shows 120 foot chamber through which cars are drawn by a double conveyor chain. Cars are mounted on special cradle or "flight" on conveyor. Burned out car body can be seen emerging from chamber at right.

There are no problems involved in gas or oil contents of a car to be burned, as normally any oil or grease in or on the car will burn along with the rest of the combustibles. Gas tank is punctured so that a car bearing 20 gals of gasoline will not accidentally be burned, and to eliminate any explosive vapors.

Question: How much does it cost to burn one car in the New York installation?

Answer: About 65¢ per car. Assuming a rate of 15 cars/hour, electricity, water and ignition oil totals 35¢/car. Labor, maintenance, tax, insurance, etc. brings the total to 65¢/car.

Question: What was total cost of the Bronx installation?

Answer: $185,000. However, other available units range in size from two, six, ten cars/hour, vary in price from a low of $25,000 depending on size, optional features.

Question: How are car bodies ignited?

Answer: In the New York unit by automatically shooting a jet of flame on car bodies as they enter the burning chamber. Some users prefer to douse them with oil and light them with a torch.

Question: What controls are installed?

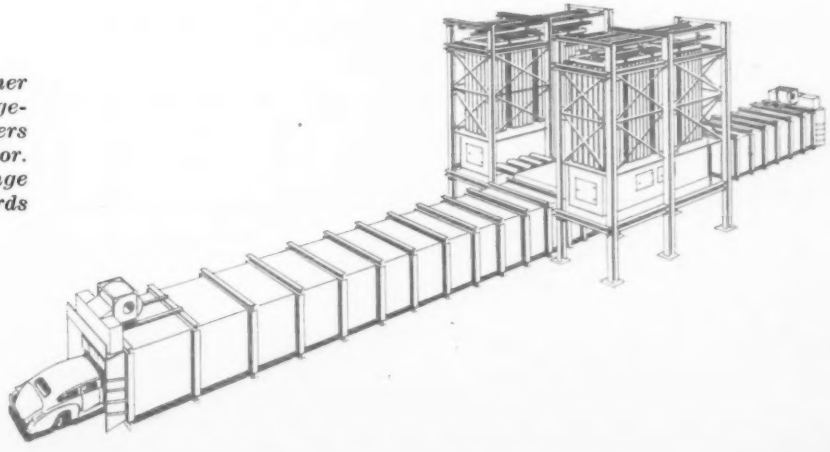
Answer: None, as such. Burning is governed by the amount of air admitted to the burning chamber. Burning limits and control can be built into each unit. There are temperature indicators to measure burning rate so that heat is kept within maximum limits for each burning unit.

Other Units

Other car burners are in operation in Atlanta, Georgia and Columbus, Ohio. As more and more cities enact regulations forbidding open yard burning of junk car bodies, additional installations of car burners are expected to be made.

Engineered car burners also point the way to fully engineered, smokeless, odor-free incineration systems for garbage burning and other waste material disposal.

Editor's Note: A future issue of AIR ENGINEERING will discuss methods of burning scrap insulated copper wire.



Sketch of car burner shows general arrangement. Center towers contain precipitator. Models available range from $25,000 upwards in price.

From Velocity Head CALCULATION OF GAS VELOCITY IN DUCTS AND STACKS

by Marvin Greene
Chemical Engineer

Pitot tubes, orifices, and Venturi meters are used to determine the velocity of a gas in a duct, pipe, or stack by measuring the velocity head. This nomograph provides a simplified means of determining the gas velocity taking into account the variables such as temperature, static pressure, molecular weight, specific gravity of the manometer fluid.

Bernoulli's theorem establishes the basis for the relationship between gas velocity and velocity head:

$$h_G = \frac{V_s^2}{2g}$$

h_G = height of column of gas, feet
V_s = velocity of gas, feet per second
g = acceleration of gravity, 32.17 feet per second per second.

The density of the gas, D_G, varies with its temperature and pressure according to the Perfect Gas Law:

$$PV = nRT_a$$

$$V_m = \frac{V}{n} = \frac{RT_a}{P}$$

$$D_G = \frac{M}{V_m}$$

$$D_G = \frac{MP}{RT_a}$$

P = static pressure of the gas, atmospheres
T_a = absolute temperature of the gas, 460 + degrees F
n = number of mols of gas
R = gas constant, 0.730 $\frac{\text{(cubic feet)(atmospheres)}}{\text{(pound-mol)(degrees F)}}$
V = volume of the gas, cubic feet
V_m = molar volume of the gas, cubic feet per pound-mol
M = molecular weight of the gas, pounds per pound-mol

Incorporating the Perfect Gas Law into Bernoulli's theorem:

$$V_s^2 = 335\,\frac{HG}{D_G} = 335\,\frac{HG\,RT_a}{MP} = 335\,\frac{HG\,(0.730)T_a}{MP}$$

$$V_s^2 = 245\,\frac{HGT_a}{MP}$$

$$V_s = 15.64\sqrt{\frac{HGT_a}{MP}}$$

H = height of column of liquid, inches
G = specific gravity of liquid
D_G = gas density, pounds per cu. ft.

SPECIAL CASE: Air as the gas in the duct at a pressure of 1 atmosphere, water in the manometer:

$$V_s = 15.64\sqrt{\frac{H\,(1.00)\,T_a}{(29)\,(1.00)}}$$

$$V_s = 2.90\sqrt{TH_a}$$

G = specific gravity of water = 1.00
M = molecular weight of air = 29
P = static pressure of the air = 1.00

Examples of Use of the Nomograph

1. R-11, which is trichloromonofluoromethane, molecular weight 137.4, is flowing as a gas in a duct at a temperature of 70 F and a pressure of 21.0 inches of mercury, absolute. The velocity head is measured as 12.5 inches of a liquid with a specific gravity of 1.90, which is the liquid in the manometer connected to the measuring device, an orifice meter with a correction factor of 0.60 for this measurement. Determine the velocity of the R-11.

Step 1. Draw a straight line from 70 F on the temperature scale through 21.0 inches of mercury on the static pressure scale and continue to the molar volume scale. If desired, the value 551 cubic feet per pound-mol may be read from this scale.

Step 2. From the intercept on the molar volume scale draw a second straight line through 137.4 on the molecular weight scale and continue through to the density scale. The reading at this point is 0.249 pound per cubic foot.

Step 3. Draw a third straight line from the intercept on the density scale through 1.90 on the specific gravity manometer liquid scale and continue to the pivot line.

Step 4. From the intercept on the pivot, draw a straight line through 12.5 on the velocity head scale and continue to the velocity scale where the intercept is read as 179 feet per second. Multiply 179 by the correction factor, 0.60, to obtain the answer—107 feet per second.

2. A mixture of 50 percent hydrogen and 50 percent methane, by volume, is piped at a temperature of 1150 F and a static pressure of 46.0 pounds per square inch, absolute. The liquid in the manometer connected to the measuring instrument, a Venturi meter, has a specific gravity of 0.70. Determine the velocity of the gas from the velocity head of 0.50 inch. The molecular weight of the gas mixture is calculated to be 9.03.

Step 1. Draw a straight line from 1150 F on the temperature scale through 46.0 pounds per square inch on the pressure scale and continue the line through to the molar volume scale where the intercept is read as 376 cubic feet per pound-mol.

Step 2. From the molar volume scale draw a second straight line through 9 on the molecular weight scale and continue to the density scale, the intercept reading 0.0240 pound per cubic foot.

Step 3. Draw a third straight line from the density scale through 0.70 on the specific gravity manometer liquid scale and continue to the pivot.

Step 4. From the pivot draw a straight line through 0.50 inch on the velocity head scale and connect with the velocity scale, where the answer is read as 70 feet per second.

3. A smokestack effluent gas has a molecular weight of 27.5, a temperature averaging 250 F, and a negative pressure of 7.0 inches of water, gauge. The liquid in the manometer on the Pitot tube is water. The velocity head measures 2.30 inches. Determine the velocity.

Step 1. Draw a straight line from 250 F on the temperature scale through 7 inches of water, negative gauge, and continue to the molar volume scale, the intercept reading 528 cubic feet per pound-mol.

Step 2. Draw a second straight line from the molar volume scale through 27.5 on the molecular weight scale and continue to the density scale where the intercept is 0.0521 pound per cubic foot.

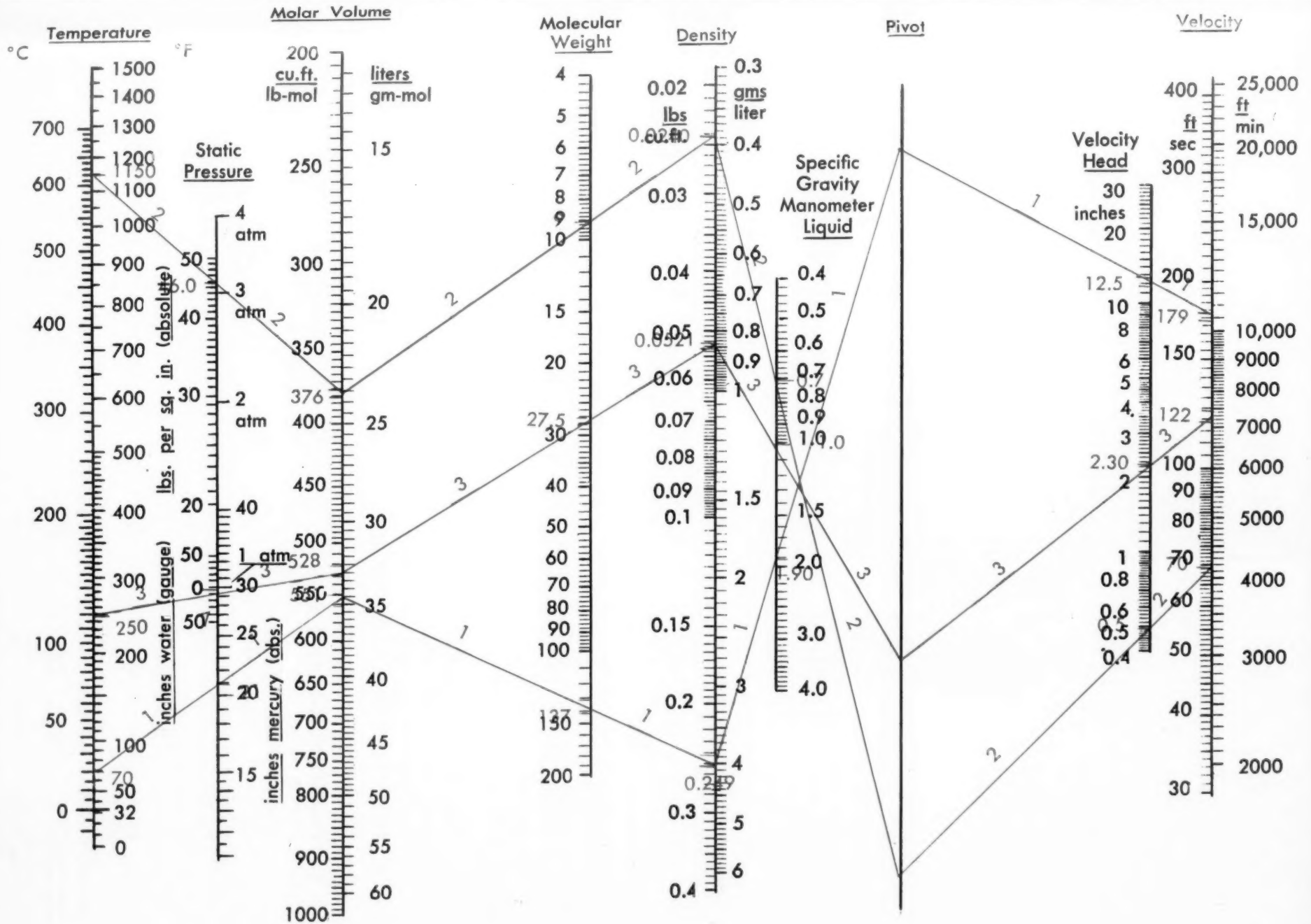
Step 3. From the intercept on the density scale draw a straight line through 1.00 on the specific gravity manometer liquid scale and connect with the pivot.

Step 4. Draw a straight line from the pivot intercept through 2.30 on the velocity head scale and continue through to the velocity scale. The answer on the velocity scale is read as 122 feet per second.

$$V_g = 18.51\sqrt{\frac{11\ (2.00)\ 2.2}{(29)\ (1.00)}}$$

The molecular weight of the gas mixture is calculated to be 9.03.

scale is read as 122 feet per second.



FOR PROCESS IMPROVEMENT, POLLUTION CONTROL, A LOOK AT . . .

Catalytic Air Treatments

For high pressure power recovery, this cylindrical type catalytic unit saves shaft power.

by **Paul H. Goodell***

Vice President-Sales
Catalytic Combustion Corporation

So vital is the role played by air in most heating processes involving the evaporation of oils, solvents, and other hydrocarbons that an analysis of fuel and power requirements will commonly reveal upwards of 70 percent of operating costs spent for safety considerations and often as little as 10 percent for the primary objectives intended. This ratio of productive to non-productive expense and subsequent costs for production losses, maintenance and fire protection, becomes the focal point in modern concepts of industrial air engineering. The principles to be used in its application include:

1. Treat air as a commodity with a "cost" and "result" value.
2. Avoid excessive and needless use of air, particularly when heating, cleaning or other types of conditioning are involved.
3. Provide positive means of supply so that air needs may be accurately sized to process requirements without needless allowance for competing demands, variable static pressure conditions and guess factors relating to process conditions.
4. Provide well designed hoods or vestibules for effective entrainment and exhausting of fumes from localized areas with minimum consumption of room air.
5. Decontaminate exhaust gases before release, thus avoiding re-entry of fumes, irritants or toxic vapors into the plant through windows or air supply system inlets.
6. Design oven heaters to consume flammable process vapors and odor constituents, thus eliminating potential fire hazards at the source.
7. Use the latent energy and sensible heat available in exhaust gases to reduce process fuel demands.
8. Where conditions do not permit practical or economical heat return to the originating process, use combustible fume correction and exhaust heat recovery for direct supply to an adjacent process such as a water dry-off oven or winter heating of building make-up air via an air-to-air heat exchanger.
9. Where climate conditions indicate preference for air cooling, rather than air heating, deliver oxidized process gases to absorption type air conditioning equipment for efficient use of available energy.
10. When elevated temperature or pressure of fume corrected gases permits, arrange for use in a waste heat boiler or gas turbine to supply heat or power needs of the plant.

****Member, Committee on Safety Standards for Industrial Ovens and Furnaces; National Fire Protection Association; Odor and Gas Treatment Committee; Air Pollution Control Association. Formerly Chairman, Electric Heating Committee, American Institute of Electrical Engineers; Process Heating Consultant for Manhattan project.***

ems a Production Tool

Here's a condensed textbook in a few pages about catalytic air treatment to reclaim waste heat, reduce operating costs and equipment investment, avoid air pollution, salvage shaft power . . . in dozens of major industries.

An important consideration in air engineering is the ability to decontaminate, reclaim and re-use process air for heating, cooling and other processes. Following nature's process of purifying by oxidation, air technology now includes means for rapid, complete and reliable oxidation of all organic and combustible type contaminants regardless of dilution, or their ability or inability to support flame propagation. This means, known as catalytic oxidation, simply requires momentary contact of the gases with a catalytic material at suitable temperature.

Practical Applications

Before describing how catalytic oxidation systems operate, let us first investigate how these units can be used on a practical economic basis for oven ventilation systems; heat treating, oil cooking; plastic curing and production; reduction of "waste" gases; effect on plant design and plant location.

Many arrangements may be employed for adding catalysts to oven ventilation systems. The diagram in Figure 1 illustrates air flow in a typical paint oven having no provision for fume correction. If the oven is operated at 350 F, the minimum heat loss will be 300,000 Btu/hour for each 1,000 cfm of 70 F equivalent gases exhausted. In addition, each 1,000 scfm (cfm at standard 70 F) of exhaust may contain 5 gals/hour of vaporized paint solvents equivalent to an additional 600,000 Btu/hour of available energy.

The simplest method of decontaminating exhaust gases from the oven illustrated is to replace the exhaust fan with a catalytic combustion system having a flow diagram as shown in Figure 2. The exhaust gases leaving the oven at 350 F are preheated by the burner to 500 F, adding approximately 165,000 Btu/hour per 1,000 scfm. However, if we now assume that each 1,000 scfm carries with it 5 gph of volatiles having an average heat combustion of 120,000 Btu/gal, the unit energy concentration of the gas stream entering the catalyst is approximately 10 Btu/scf. As a result, the temperature rise in combustion of these fumes as they pass through the catalyst will be equal to:

$$10 \times 55 = 550 \text{ F}$$

Since the temperature entering the catalyst is already 500 F, it can be seen that the stack gases leaving the system will be approximately 1,050 F. They therefore carry to the atmosphere total energy above normal ambient of approximately 1,080,000 Btu/hour, for each 1,000 scfm, or an amount very

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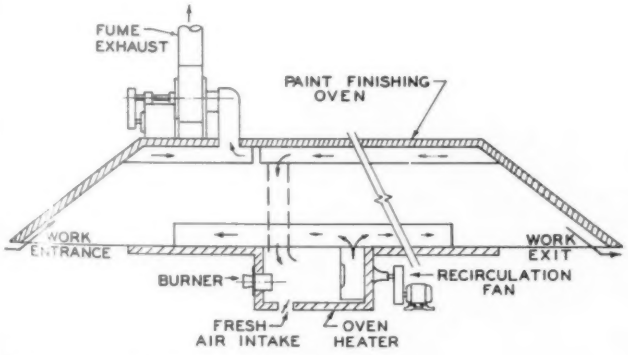

Fig. 1: Without air correction, continuous industrial type oven used to bake paint finish.

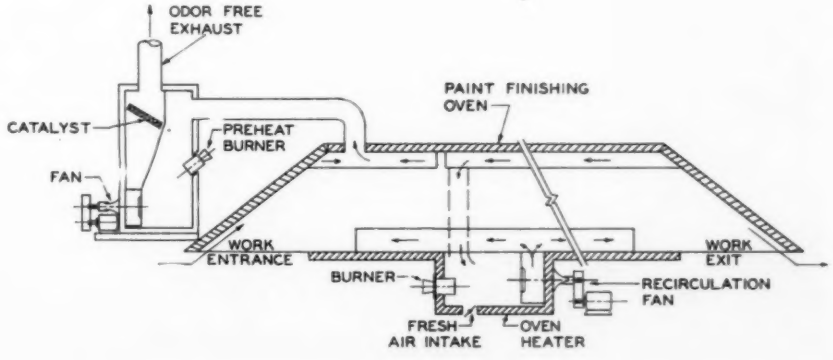

Fig. 2: Catalytic exhaust correction system as applied to continuous solvent evaporation or paint baking oven, without provisions for heat recovery.

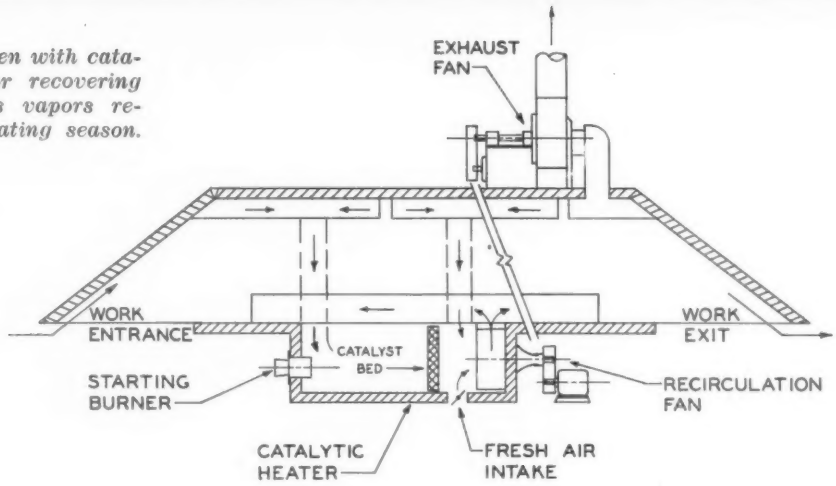

Fig. 3: Continuous oven with catalytic type heater for recovering energy from process vapors released during the heating season.

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likely exceeding the corresponding heat demand of the oven.

As an appendage to the oven, catalytic fume correction may be highly profitable when arranged for efficient heat recovery. However, it should be noted that preheat, control and other elements in the fume destruction system duplicate similar functions included in the original oven heating system. This suggests consideration of integrated design as illustrated in Figure 3. Here the catalyst becomes a basic component in the oven heater, adding little to the bare oven cost and size in relation to the many functions performed, and assuring proper coordination of design by the oven builder. The new heater delivers constant temperature air to the oven without regard to its source of supply from the catalyst or the conventional oven burner. By added measurement of temperature rise through the catalyst, an alarm can be sounded or feeding of additional load can be interrupted to prevent accidental build-up of fume concentrations above safe preset limits. A typical installation of this type is shown in Figure 4.

While this illustration is confined to industrial ovens, it is not difficult to visualize similar comparisons for equipment used in other fume generating processes. Vaporization of oils in heat treating operations, original cooking of oils, resins and varnishes, impregnation and curing of these materials in paper and cloth, and various plastic manufacturing operations, all provide opportunities for coordination of air supply, disposal and heating operations.

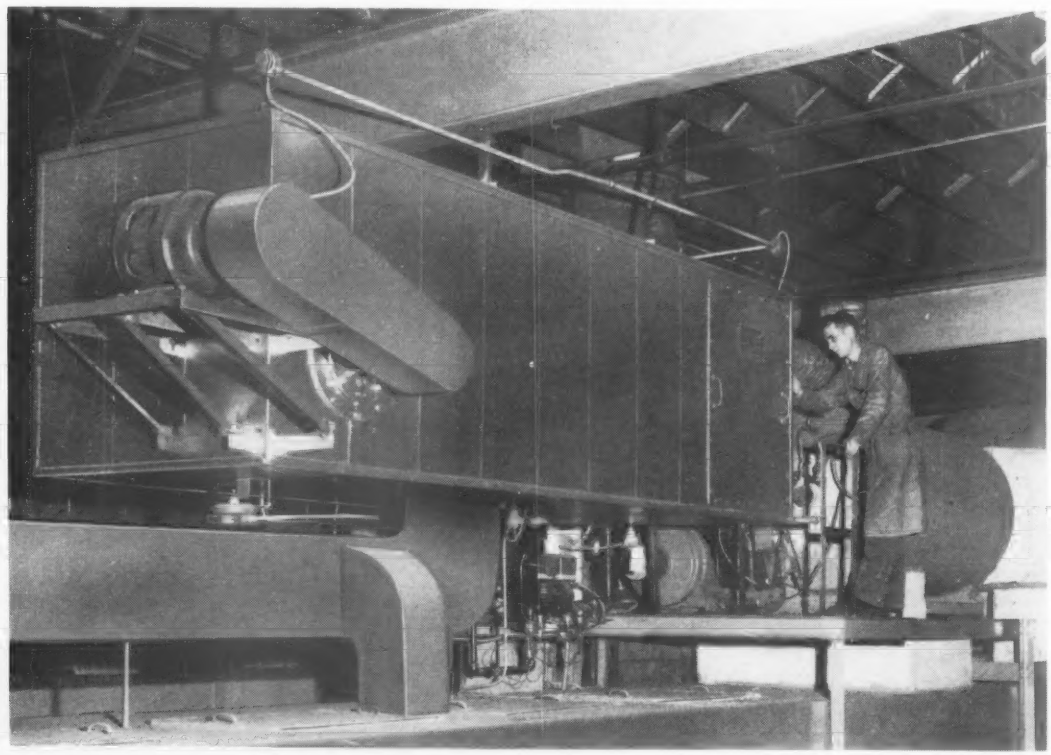

Fig. 4: Remote, catalytic type oven heater. Fume concentrations can be kept within safe limits by measuring temperature rise through catalyst with alarm to indicate undue fume concentration.

A still more striking example of the influence of air engineering on the destruction of waste gases and its influence on plant equipment design occurs in pressurized chemical manufacturing processes such as the production of ethylene oxide and nitric acid. Tail-gases, after completion of manufacturing operation, are at elevated pressure and are frequently contaminated with product carry-over and added reactant gas. By the use of a catalytic pressure reactor to raise tail-gas temperature, while at the same time consuming the contaminants, as shown in Figure 5, substantial quantities of shaft power can be produced by addition of a gas turbine. A typical Nitric Acid Plant without waste gas power recovery formerly used a 3,000 hp motor to compress supply air. With the catalytic reactor, a motor drive of one-third this size is now used to start plant operation at partial flow rate until heat generated by the catalyst raises available power from the turbine to bring the plant to full flow condition. Use of the catalytic reactor not only provides air pollution control, but it greatly influences plant electrical demands and related transformer facilities. A catalyst for this type of high pressure operation is illustrated in Figure 6.

Influence on Plant Design

The use of air engineering principles as described will also provide numerous advantages in future plant design. By removing major air demands from central heating systems, boiler capacity is reduced. Equipment location becomes more flexible, and decontaminated exhaust streams can use lower and less expensive exhaust stack construction. Lacking offensive exhaust emissions, plant location itself may become more flexible, permitting selection in closer proximity to end customers.

Catalysts for Air De-Contamination

A variety of metals exhibit catalytic qualities under certain types of surface preparation. Nickel, silver, vanadium and manganese all have some desirable catalytic properties, and this group of metals are usually classified as "mild" catalysts. They are used extensively in chemical manufacturing operations to produce partial oxidation reactions.

Platinum group alloys are usually recognized as "harsh" catalysts because of their tendency to produce complete oxidation, and to accomplish this at minimum operating temperatures. Alcohol vapors will usually oxidize on platinum catalysts at temperatures of 200 F to 300 F, naphtha and gasoline vapors at temperatures in the range of 450 F to 500 F and fumes from pitch, tar and asphalt will consume at temperatures in the range of 700 F to 750 F. The end products resulting from oxidation of organic or hydrocarbon vapors are trace amounts of carbon dioxide and water vapor, both inert gases already present in air.

Catalytic Element Design

Catalysts employed for oxidation of organic and combustible type fumes are usually constructed in "element" form similar to that illustrated in Figure 7. In appearance, the element is not unlike that of a metallic air filter. To assure the desired dwell time of the gases in the catalyst bed, large flow rates may be handled by multiple use of elements in a gasketed frame, as shown in Figure 8, which is arranged to prevent by-passing in the insulated housing. The element is suitable for operating temperatures in excess of 1600 F. Pressure drop through the catalyst is usually below ½ in. water column at normal rated volume.

Thermal Effects from Catalysis

Burning of fumes as they pass through the catalyst bed results in an increase in temperature of the gas stream, proportional to the energy concentration of dilution of the combustibles present. Thus, the release of 1 Btu of latent energy in 1 cu. ft. of 70 F equivalent air (1 scfm) produces a 55 F temperature rise in passing through the catalyst bed. Under normal operating conditions, combustible fume con-

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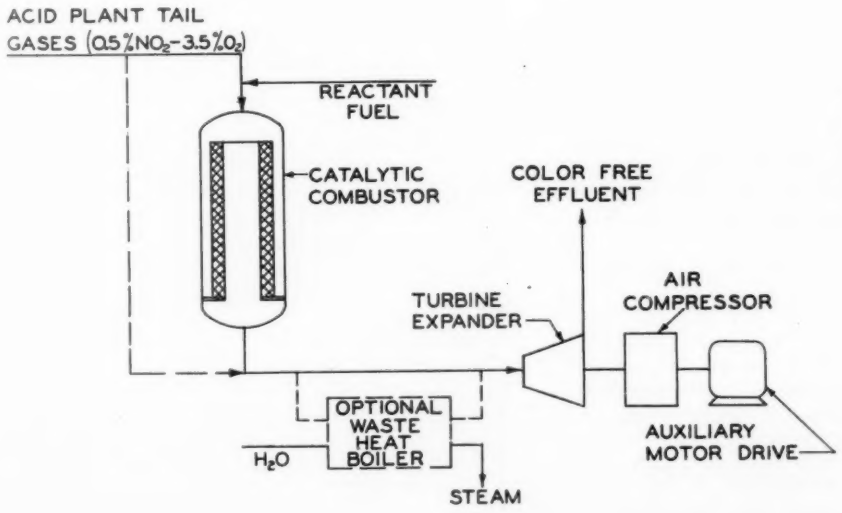

Fig. 5: Catalytic combustor for power recovery and reduction of nitrogen oxides in acid plant waste gases.

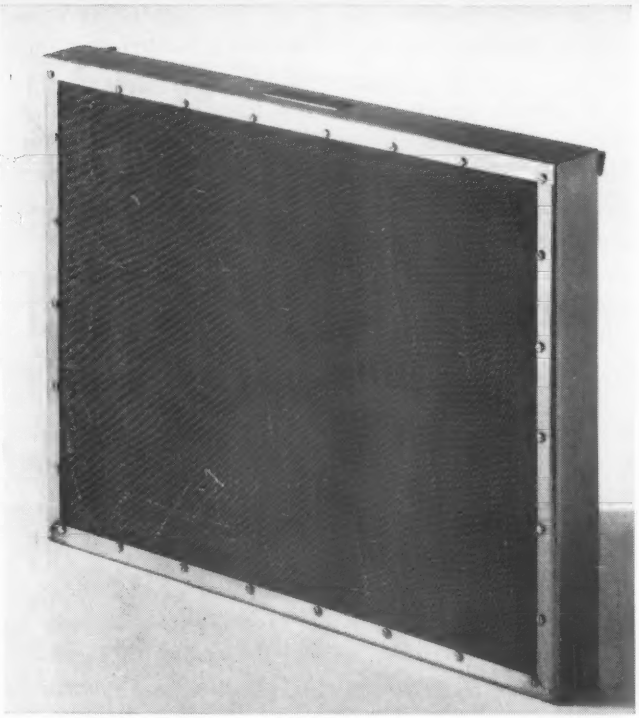

Fig. 7: Typical "all-metal" catalyst element used to consume organic and combustible type vapors.

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stituents are diluted below 12 Btu/cu. ft., thereby limiting the heat release in the catalyst to approximately 660 F.

For purposes of comparison, an ideal combustible mixture for use in a conventional burner usually contains just sufficient air to complete the combustion reaction. For fuel gases containing 1,000 Btu/cu. ft., this result is obtained when one part of fuel gas is mixed with nine parts of air, thus providing a heat value of 100 Btu/cu. ft. at the burner head. From this comparison, it is obvious that catalysts are operated far below flame propagation limits; permitting the catalyst to consume combustible type vapors without danger of the combustion reaction migrating away from the catalyst surfaces.

Since the catalyst causes oxidation to occur without itself entering into the reaction, it might be assumed that catalysts have infinite life. This would be true, were it not for the attrition and contamination resulting from the presence of small quantities of inorganic dust particles in the gas stream over long periods of operation. In actual service, the catalyst element is normally in use for six months to one year without attention. Contamination is removed by washing the element in detergent and hot water or by giving a dip in dilute nitric acid. After operation for periods ranging from three to six years, the element is returned to the factory where a new platinum coating is applied at approximately one-fifth of the initial cost to provide another life span.

A substantial number of catalyst installations have now passed 30,000 hours of service before requiring factory reactivation.

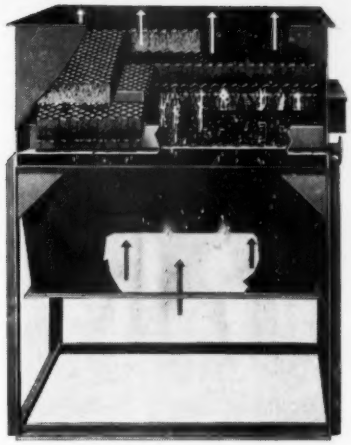
The method and completeness of air correction will not only influence its cost, but more importantly, will often add to or reduce operating costs, safety and quality considerations for the processes being served. Thus, the technology of air utilization becomes an important consideration in modern plant operation and design.

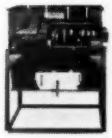
Many Benefits

Thus catalytic oxidation processes can prevent air pollution at the source; provide for economical recovery and reuse of heat from process systems; reclaim valuable materials; reduce operating costs; increase plant design and plant location flexibility.

Fig. 8: Right, multiple use of catalyst elements for processing large volumes of waste gases.

This new unit stops destructive plant mists and vapors



This is the Type M Cycoil,  newest product of AAF dust control research. It is a special dust collector designed to do a specific job: collect the mists and vapors that ruin automobile finishes, plant roofs and neighborhood home exteriors. It does its job well. It is higher in efficiency, lower in cost, lighter in weight and less space-consuming than conventional collectors used for this service. Bulletin 286 describes the Type M Cycoil in more detail.

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Mr. Robert Moore
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New Way to Collect Plating Fumes

Application of new type of polyethylene wet pad fume collector for small parts plating. Methods of combatting effect of severe cross drafts from any open windows on fume collection. Installation costs plus operating data on units.

by David Moore
Facilities Design Engineer
***Burroughs Corporation,* and**
Ivan W. Dyer
Sales Engineer, American Air Filter Co.

Inadequate make-up air, corroded hoods and ducts, heavy fume loading from tank agitation all added up to a fume collection problem in the small parts plating plant of the Burroughs Corporation, Detroit.

Gradual addition of new tanks in the plating department, without additional ventilation air . . . fact that 85 percent of the ductwork, 75 percent of fume hoods were corroded . . . supply make-up air totaled only 87.5 cfm/sq. ft. for every 320 sq. ft. of open tank solution area, pointed up need for a complete new fume collection system and make-up, ventilation air system.

Cross-Drafts a Problem

The fume collection problem was further complicated by: 1. Cross drafts from open windows. During summer months especially, plating personnel opened windows, caused strong drafts across plating tanks that blew fumes away from hood openings. A potential health hazard from acids and alkalines existed. 2. The agitation plating operation, in which racks bearing up to 80 small parts, were dipped into and removed from tanks, caused a heavy fume concentration as racks came out of the solution; fume collection capture velocity was not sufficient to collect all the fumes at instant of maximum fume concentration.

New Ventilating System

The new ventilating system at Burroughs requires 48,600 cfm for approximately 400 sq. ft. of surface area. This exhaust rate meets Industrial Hygiene Standards (as set by ACGIH Manuals). Make-up air is provided by two 20,000 cfm heating and ventilating units. The distribution ducts and discharge grills are located near the ceiling. Outlet velocity is low and there are no noticeable cross-drafts. Hoods and ducts from the old system which were still in good repair were used in the new system. But none were used which did not give adequate fume control. Design data and description of system is given in detail on Table I.

Size, type and number of mist and vapor collectors for this system were selected on the basis of the following general factors:

Efficiency Requirements

Approximately 94+ percent Sulphuric, 99+ percent Chromic Acids desired.

Volume of Discharge Water

Used to dissolve or contain fumes
Estimated at maximum of 60 gph.

Space Requirements

Not to exceed available floor space of 8′ x 27′ and 13′ height for collector and fan. Substantially less desired – minimum of 350 cfm capacity per sq. ft. of floor space collector only.

Fig. 1, above, shows mist and vapor collection system at Burroughs Corporation. Fig. 2, top left of page, shows close-up of collector units, view of inlet side of bank of Cycoil collectors.

Fig. 3: Outlet side of bank of mist and vapor collectors. Exhaust fan is at right. System was designed to collect vapors at maximum peak concentration, when plated items are agitated during plating.

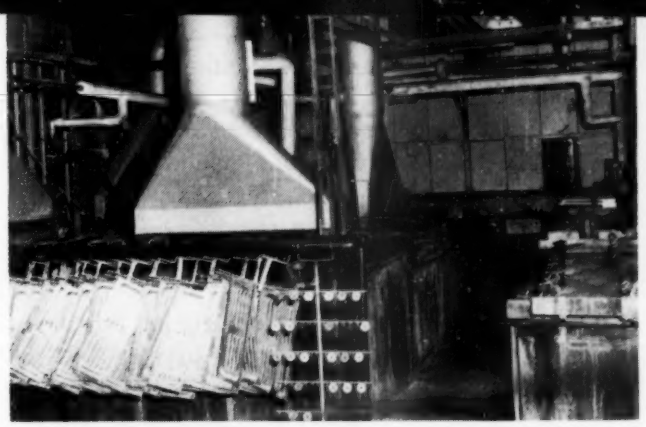

Fig. 4: Alkaline tanks shown above have specially designed exhaust hoods to collect fumes and mists despite strong cross drafts during summer when employees open plating department windows.

Air Pressure Drop, Horsepower

To meet above efficiency, at given air volume, equipment with 1.6 static pressure w.g. required, demanding 46.8 hp, open type 50 hp motor used. Capacity 60,000 cfm at maximum 2.0 static pressure w.g.

Life Expectancy

Few changes anticipated in system in two to three years. Generally, an expectancy of 15 to 20 years is not an unreasonable demand for moderately priced collector.

Price

Generally, a price of $1.00 per cfm is considered maximum for average installation. This installation cost approximately $0.50 per cfm (less air make-up). Savings were realized on re-use of some ducts and hoods. Low equipment and installation cost reduced expenditures.

Collector installed was a polyethylene wet pad fume scrubber, of the type shown in Figure 1. It is designed to achieve a higher collection efficiency than conventional wet dust fume collectors, yet it is lighter, less bulky and lower in cost. It is specifically designed for plating applications. It may be operated either as an exhaust or blow-through cleaner, with the contaminated air or exhaust gas flowing upward through a perforated plate into the eliminator section.

Eliminator section consists of a fluid-bed, polyethylene pad into which water is introduced on a perforated plate and picked up by air flowing upward through it. Moving air causes a liquid level to be established in the polyethylene media and subsequently provides a multitude of flooded contact surfaces for effective scrubbing, as shown in Figure 1.

Excess water is forced to the sides of the eliminator section and thence downward to a drain pan. Normal water drain rate is 1 gal or less for each 1,000 cfm. Water drain-rate is carefully maintained by a sensitive control box. Actual water drain rate on all collectors in this installation has been measured at 54 gph. Supply water line pressure is 20 psi,

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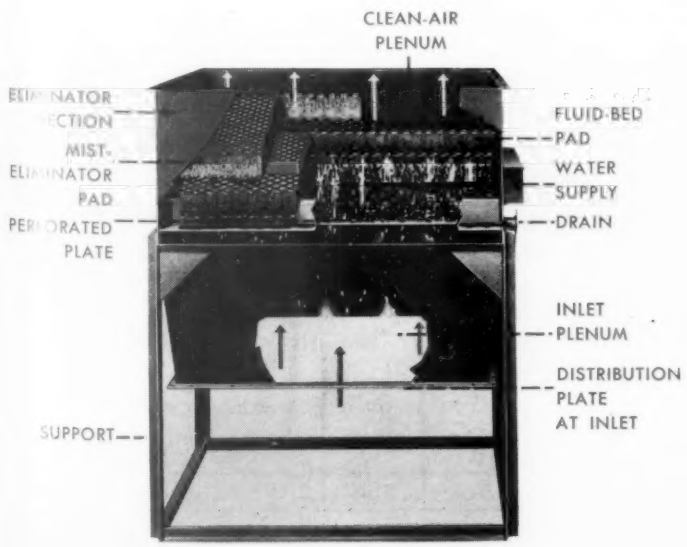
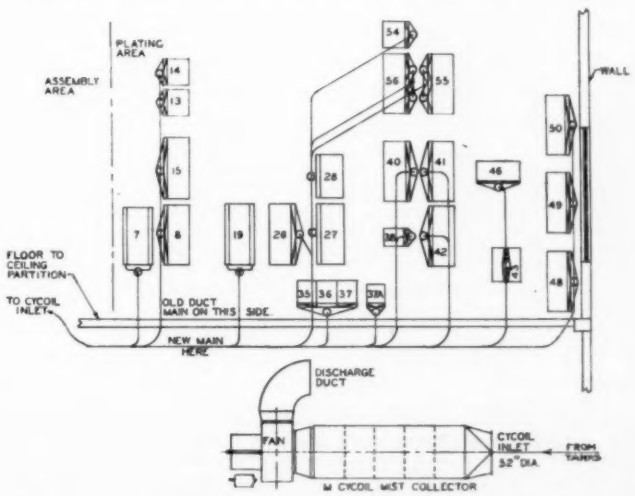


FLOW CHART OF FUME COLLECTION SYSTEM



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adequate to operate controls. Neither costly pumps nor troublesome spray nozzles are needed. There are no heavy retention tanks required. Any water which is not collected (as mist) in the fluid level pad is automatically removed by a secondary pad above the first.

Air Resistance Low

Air resistance across each collector at Burroughs is only 1.6 in. w.g. The inlet duct resistance is 2.0 in. w.g. and the outlet duct resistance is 0.90 in. w.g. A perforated plate for better air distribution is fixed to the flat opening of the air inlet plenum. Total resistance is low enough to allow use of the relatively inexpensive Class II fan. Class II fan has a low horsepower consumption.

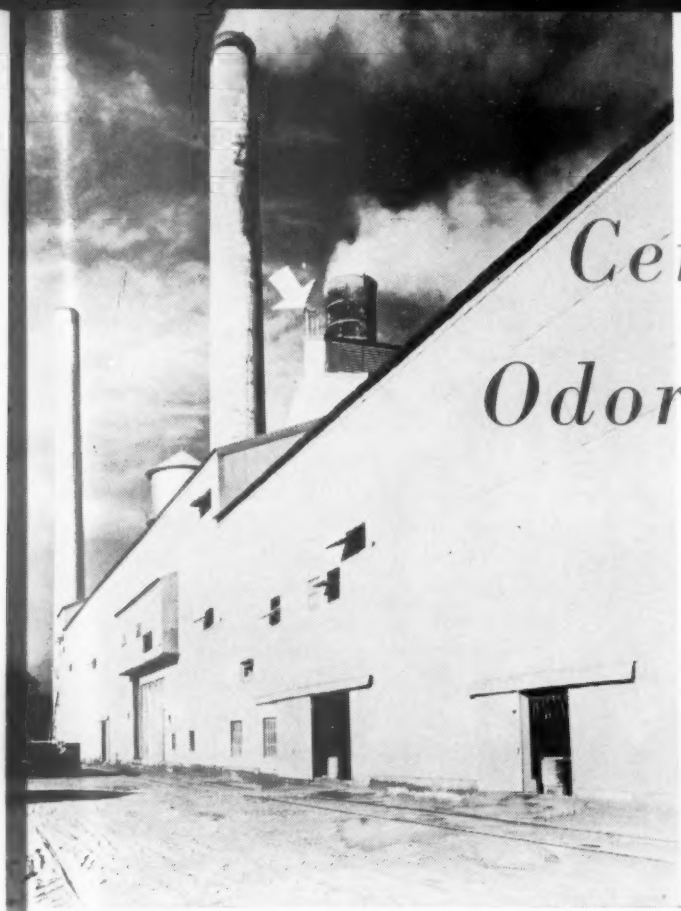
The air inlet and outlet are at opposite ends of the bank of collectors at Burroughs. Five units are installed in parallel, as shown in Figure 2. Air enters through the bottom and leaves through the top of each collector. (Manifold arrangement.) This arrangement uses minimum space, and allows installation flush with wall (floor to ceiling partition) in the plating rack area. The exhaust fan is a Class II GBZN unit, with backwardly curved blades. Operating speed is 674 rpm at 45.8 hp.

(Please turn to page 64)

TABLE—TANK VENTILATION SYSTEM

Tank No.	OPERATION	Temp.	Tank Size	Design CFM	Actual CFM	CFM/Sq. Ft. of Tank Area (Design)	Slot Area Sq. Inches	Slot Size	Design Slot Vel. Ft./Min.	Duct Diameter Inches
7	Chromic Acid	110 F	2.5′ x 6′	2250	2220	150	144	2 Sides 1″ x 72″	2250	12
8	Alkaline Cleaner	212 F	2.5′ x 7′	2620	3460	150	210	2½″ x 84″	3460	10
13	Hot Water Rinse for H_2SO_4—7%		2.5′ x 3′	750	990	100	60	2″ x 30″	1800	6
14	NA_2CO_3 Rinse	200 F	2.5′ x 3′	825	1200	110	70	2½″ x 30″	1700	7
15	Alkaline Cleaner	212 F	2.5′ x 7′	2620	3180	150	288	4″ x 72″	1300	10
19	Chromic Acid	130 F	2.5′ x 6′	2250	1900	150	144	2 Sides 1″ x 72″	2250	12
26	Alkaline Cleaner	212 F	2.5′ x 7′	2620	1905	150	252	3″ x 84″	1500	13
27	Alkaline Cleaner	212 F	2.5′ x 7′	2620	2000	150	252	3″ x 84″	1500	12
28	Alkaline Cleaner	212 F	2.5′ x 5′	1875	2700	150	168	3½″ x 48″	1600	10
38	Chem. Black Caustic Dip	290 F	2′ x 2′	400	600	200	84	3½″ x 24″	700	5
35-6-7	Nickel Strip	130 F	2.5′ x 7′	3000	3620	175	396	2 Slots 4″ x 81″ 1″ x 72″	1100	14
37-A	Chromic Acid and H_2SO_4	150 F	1.8′ x 2′	630	695	175	72	2 Slots 1″ x 24″ 2″ x 24″	1250	6
40	Cadmium Plating Cyanide	70 F	2.5′ x 7′	2630	2540	150	168	2″ x 84″	2250	13
41	Alkaline Cleaner	212 F	2.5′ x 7′	2620	2540	150	210	2½″ x 84″	1800	12
42	Alkaline Cleaner	212 F	2.5′ x 7′	2620	2310	150	210	2½″ x 84″	1800	11
43	Water Rinse	212 F	3.5′ x 4′	1820	1630	130	123	3″ x 41″	2150	12
46	Chrome Strip Alkaline Cleaner	212 F	2.5′ x 5′	1900	2020	225	126	3″ x 42″	2150	13
48	STRIP TANKS: 1 Muriatic—50% 2 H_2SO_4—50% HNO_3—50% 3 H_2SO_4—50% HNO_3—50%		Total 2.7′ x 7′	2630	2350	150	336	1-Hood Wall—2 Sides 2″ x 84″	1100	13
49	Alkaline Cleaner	212 F	2.5′ x 7′	2630	2220	150	336	2 Sides Down Draft 2″ x 84″	1100	14
50	Alkaline Cleaner	212 F	2.5′ x 7′	2630	2300	150	336	2 Sides Down Draft 2″ x 84″	1100	15
54	Hot Water Rinse for H_2SO_4—7%		2.5′ x 3′	750	1050	100	88	4″ x 22″	1250	9
55	Copper Plating Cyanide	130 F	2.5′ x 7′	2630	2480	150	210	2½″ x 84″	1800	14
56	Copper Plating Cyanide	130 F	2.5′ x 7′	2630	2690	150	210	2½″ x 84″	1800	14
				TOTAL.....	48,600					

Cement Plant Odor Reduction



Calcium sulfide fumes caused serious odor problem from this cement plant in Buffalo, N. Y. Arrow indicates location of wind-activated control transmitter unit governing odor counteraction spray.

Scientific odor counteraction ends odor problem for this cement plant in Buffalo, N. Y. Calcium sulfide and other odors were eliminated.

Despite precautions taken by modern plant management, odors from the Federal Portland Cement Company plant in Buffalo, New York, created an odor problem for an adjacent residential area. Although located on the shore of Lake Erie, when the winds blew across the lake, the odors which smelled like "hydrogen sulfide" would be swept into residential areas adjacent to the plant. Residential areas affected extended for a radius of ½ mile. In order to reduce the problem, plant management consulted with Airkem, Inc., odor control firm with headquarters in New York.

Engineers from Airkem, Inc., working with members of the cement plant staff, evolved an interesting installation. The problem as it was determined was not toxicity, corrosion, or paint discoloration, but rather a community relations problem brought on by a mixture of several odors, of which calcium sulfide is the most readily detected.

Process of manufacturing Portland cement involves use of a raw mix composed of approximately 75 percent high grade limestone obtained from a northern Michigan quarry and 25 percent of a blend of shale and clay. These materials are intimately ground together in a ball mill with about 33 percent of water to form a slurry. Slurry is pumped to the rotary kilns where it is "burned" into Portland cement clinker. Two rotary kilns, 11 ft. in diameter and 175 ft. long, are mounted on a slope or "pitch" of ½ in. per linear foot of length and are rotated at a speed of 48 rpm. Production rate is approximately 3,000 barrels (564 tons) per day.

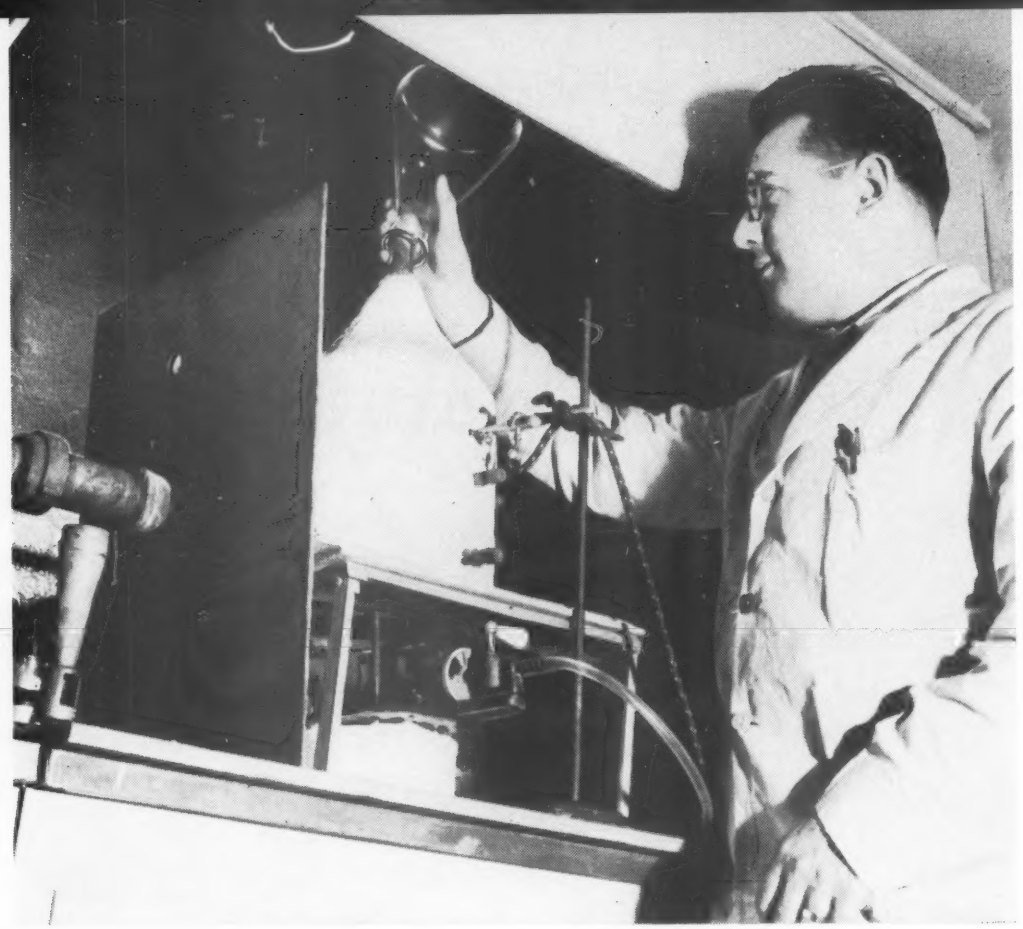
Where Odors Originate

The "burning" process consists of pumping slurry into the high end of the kiln where the material comes into contact with exit gases of the kiln, which have a temperature of 800 F. As the material is moved forward by rotation and pitch of kilns, the material temperature is gradually raised until material is about 30 ft. from the discharge end, where a hot zone of 2750 F to 2850 F is maintained. Here the raw materials are recombined into Portland cement clinker.

Temperature of the clinkering zones is produced

(Please turn to following page)

EQUIPMENT INSTALLED	
Odor counteractants:	Airkem, Inc.
Air guns for odor spray:	Paasche Airbrush Company
Air speed, direction unit:	Friez Instrument Division, Bendix Aviation Corporation.



Chemist recreates source of cement plant odor in small scale kiln in laboratory. Technique is used to obtain odor samples for comparison tests.

(Continued from preceding page)

and maintained by direct firing unit coal mills. Bituminous coal is used for heat. It is specially selected for a low sulfur content and a high thermal value.

Air necessary for combustion is supplied in part by the coal mill fan, which blows coal into the kiln, and the remainder by an induction fan located at the rear, or feed, end of the kilns which draws approximately 75,000 cfm of gases through each kiln and discharges into a scrubber. Here, kiln gases are washed with water to remove dust and any sulfur dioxide that did not get oxidized within the kilns. Kiln gases pass from washers into kiln stacks, which were the point of concern, because of trace amounts of sulfides from coal plus polysulfides from raw materials which were noticed when atmospheric conditions were right.

Two original kiln stacks were made of concrete, 14 ft. in diameter at the base and 10 ft. in diameter at the top, and 205 ft. high. Later it was found necessary, in the interest of safety, to reduce height of one stack to 50 ft. Because of this loss of height, gas from that stack reaches the ground before the other, and therefore is more concentrated.

Nose Knows Odors Best

Unfortunately the only sensitive analytical device available in odor control work is the human nose. Therefore, the conclusions are based on results obtained from field reports. Since odors are frequently detected in concentrations of one to ten parts per million, or even in the more offensive types at a dilution of one to ten parts per billion, the installation must be extremely effective to satisfy an extensive residential area of its effectiveness.

Airkem odor counteraction formulas are developed from the discoveries made by a Flemish scientist, Hendrick Zwaardemaker, in 1895. He discovered that certain substances which were odorous separately were free of odor when combined. Many odorous but mutually neutralizing odor pairs were discovered. A typical modern odor counteracting pair are the vapor phases of ammonia and ionone. When the two vapor phases are combined, neither is evident to the observer.

Counteraction vs. Masking

Technique of odor counteraction is quite distinct from odor masking. Principle of masking is to employ a generally pleasant odor in sufficient concentration to cover the offending odor. In this process, if the two odors are of about equal strength a blend of both will be detected. When the masking odor is stronger, it alone will be perceived.

Contrasted with the strong odor level established by the masking technique, is reduction in odor intensity obtained by odor counteraction. Odor counteraction leaves no overriding odor, neither pleasant nor unpleasant. Development of odor counteractants has

been through pure "Edisonian" research. In the Airkem laboratory over 4000 odors and odor counteractants have been evaluated. Because industrial odors are actually a complex group of odors, Airkem industrial formulas, although designed for specific odor descriptions, may contain complex groups of counteractants.

Nose vs. Olfactometer

When Airkem field engineers identified odors from kilns of the Federal Portland Cement plant, and measured their intensity, solution of the problem was undertaken in odor counteraction laboratories in New York. There the odor may be synthetized with special equipment developed by odor chemists. Laboratory odor counteractants are combined in basic groups. These groups are compared with the malodor constituent by the use of the olfactometer, which is an instrument that combines the odors in measured quantities in terms of parts per million. In spite of the elaborate equipment used, the human trained nose is the analytical instrument that determines counteraction conclusion. Hundreds of tests are made with various basic components to establish a combination of odor counteractants that completely diminishes the malodor as far as the layman's nose is concerned.

Odors and Meteorology

A successful application in the laboratory does not guarantee success in the field. Variations in results are due to air inversion, horizontal dispersion of air movements, and conditions of fog, mist and heavy rain. Observations are made under all these conditions at hundreds of points within a practical radius of the plant over a period of 20 to 30 days to establish results.

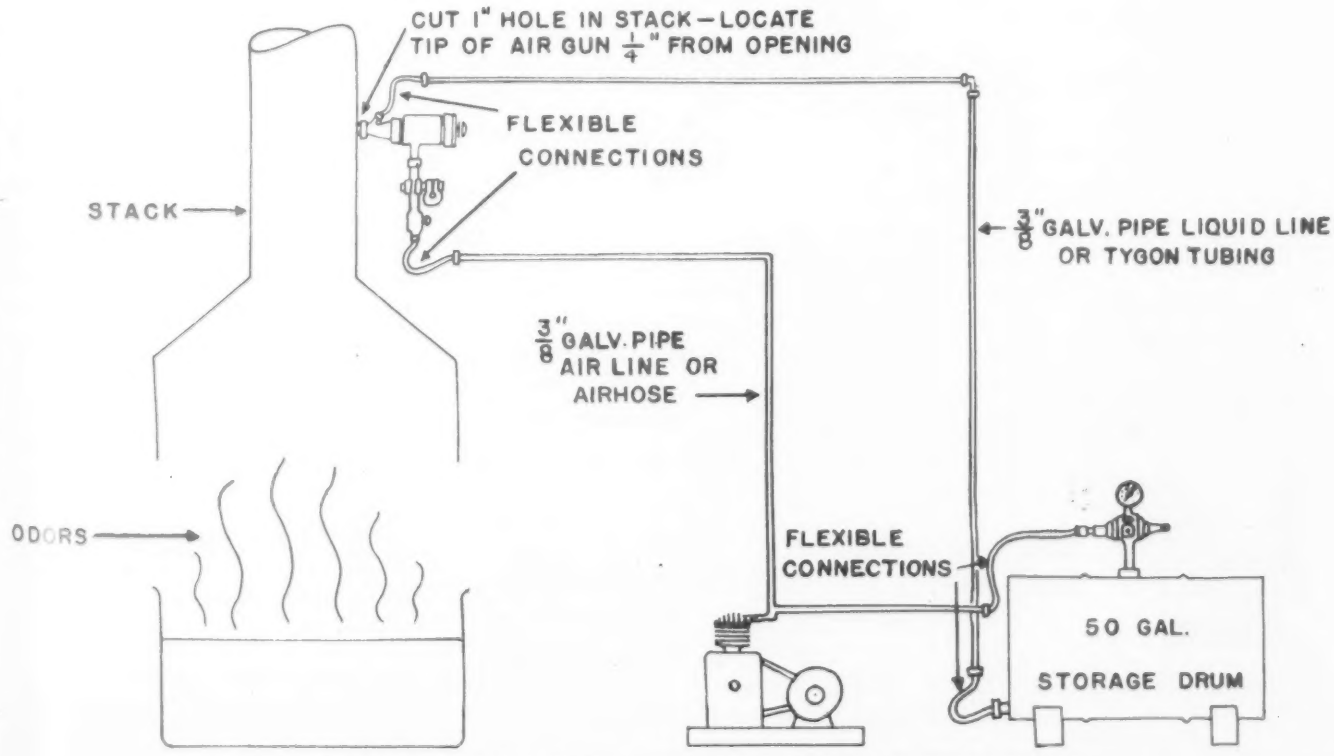
Standard equipment required for application of odor counteraction is installed in a relatively simple and inexpensive manner. Odor counteractant is atomized into the air stream of the odorous exhaust by means of a calibrated atomizing nozzle. Counteractant vaporizes and is combined with the air stream by molecular dispersion.

Regardless of whether the stream of exhaust is held to the ground by air inversion, is vertically dispersed, or horizontally dispersed, counteractant is carried with the malodor and is noticeably effective until the odor is completely dispersed. Atomizing equipment is readily adaptable to any stack or working area. It is simple, requires little or no service and is easy to install. No alterations are required in process equipment, and no downtime is required for installation.

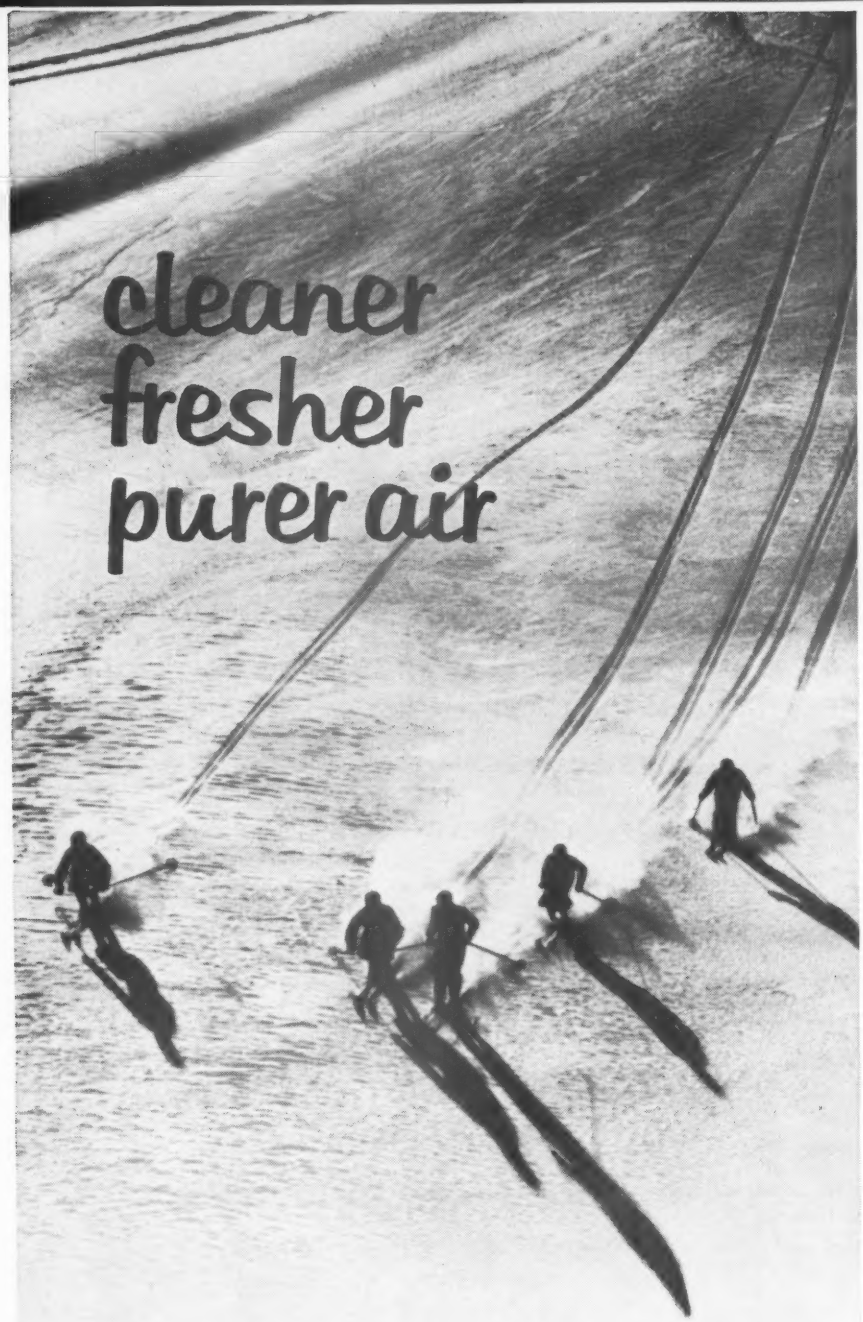
Evaluation of results of odor counteraction in the field area is a rather simple process for the trained observer. Evaluation of success of odor counteraction application by plant officials is not so easy. Explanation lies in the fact that there is a wide variation in people in ability to perceive odors. Some people find malodors pleasant, and others find what normally would be called "pleasant odors" unpleasant.

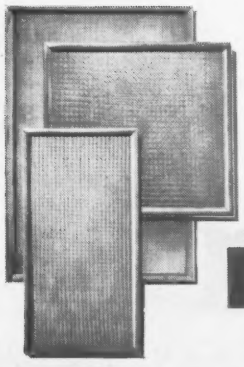
An odor counteractant used in industrial work areas or in industrial stacks for control of atmospheric

(Please turn to page 67)


CUT 1" HOLE IN STACK—LOCATE TIP OF AIR GUN 1/4" FROM OPENING
FLEXIBLE CONNECTIONS
STACK
3/8" GALV. PIPE LIQUID LINE OR TYGON TUBING
3/8" GALV. PIPE AIR LINE OR AIRHOSE
ODORS
FLEXIBLE CONNECTIONS
50 GAL. STORAGE DRUM

TYPICAL LAYOUT FOR SPRAY GUN OPERATION





Air dust-free as wind-scoured mountain slopes! Dust-magnet filters are electrostatic, trapping particles small as 1/10th of a micron. Permanent, non-clogging . . . when dirt-laden simply rinse clean and replace in unit. Available for furnaces and air conditioners. As you live and *breathe* . . . install Dust-magnets!

DUST-magnet FILTERS

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Metalworking

(Continued from page 37)

probably incorporating some type of a heat recovery system. In this manner large volumes of unnecessary excess air can be avoided and the size and cost of the control system reduced.

Pulverized coal-firing air melting furnaces and annealing ovens will require a more extensive use of fly ash control systems or they are destined to be replaced or converted to oil or gas fired units. Much has been done by the metal working industry to clean up its emission problems. We are confident that the increased attention given to this problem by the industry, and other interested groups, will result in even greater progress in this field in the near future.

Plating Fumes

(Continued from page 60)

Collectors are protected against corrosion by a coating of baked-on polyvinyl chloride .080 to .120 in. thick. Fan and the discharge duct and stack are not protected against corrosion because of the high efficiency of the collectors.

Collector Tests

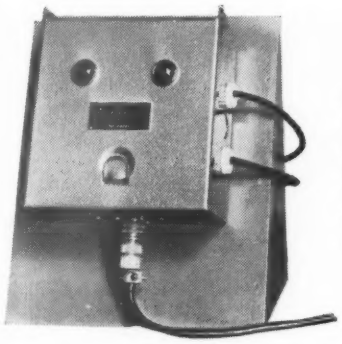
Tests run on collectors at Burroughs by George D. Clayton & Associates, industrial health consultants, Detroit, indicated that "based on the average of the test run, efficiency of the collector tested was 94.9 percent for chromates, 92.8 percent for sulfates and 86.9 percent for solids. Results indicate high efficiency for collecting contaminants from plating operations."

Through careful planning, engineers at Burroughs, supplier's field consultant, and contractors were able to complete all renovations during a two-week factory shutdown period. There was no loss of valuable production time. The system has worked well.

EQUIPMENT INSTALLED

Type M CYCOIL Mist and Vapor Collectors, American Air Filter Company.

Exhaust blowers, Herman Nelson.



Top: Vane control air unit of type mounted on roof of cement plant. Left: Vane transmits wind velocity and direction to control box.

(Continued from page 63)

odor pollution should be non-toxic, non-allergenic, non-flammable, non-corrosive, chemically inactive, economically feasible, and should be effective in the laboratory and in the field. Odor counteractants should not be used for removal of particulate material, nor should they be used where toxic materials exceed maximum allowable concentration in the air for that toxic material.

Original installation made at the Federal plant utilized an air gun installed at the base of each stack. The guns sprayed a fine mist of Airkem odor counteractant into the stack at the rate of approximately three pints an hour. Control of the equipment was left to the plant personnel.

Meteorological Effects

Further study showed that the continuous operation of the system was not required since wind shifts often carried the odors over the lake. Manual control of vaporizing units meant that human lapses would leave possibility of odor contamination when winds carried over the residential area. When wind velocity is such that kiln stack effluent rises lazily upward, no treatment of gas is required. In addition, wind direction and velocity are not constant but vary widely over a 24-hour period, so much so that efficient manual operation was not to be expected.

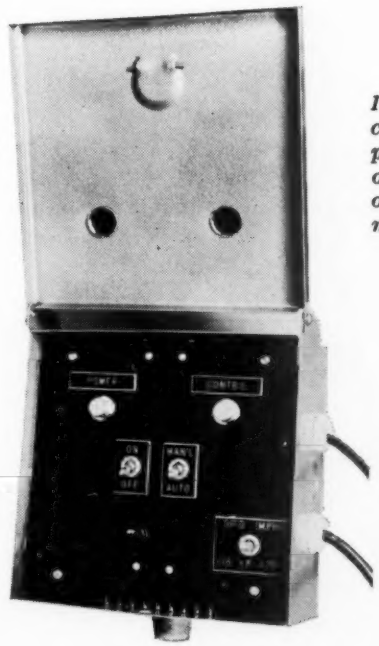
Answer was instrumentation. A "Vane-Control-Air" unit was installed. This instrument is an electromechanical device consisting of a wind speed and direction transmitter and a controller, which can be used for controlling a process or warning where wind speeds and directions are critical. After a trial and error period, it was found that stack gas treatment was not needed when wind blew gases over the lake, or when wind velocity was less than 5 mph.

The vane was mounted as near the stacks as practical, and 100 ft. above the ground to avoid stray eddy currents near ground level. The transmitter is constructed so that controller circuit is energized when wind speed is less than a chosen value and when wind is from a specified arc; or either speed or direction can be controlled independently. In normal use, however, both conditions must exist simultaneously.

In operation, when wind is blowing gases toward the land area at a velocity greater than 5 mph, switch in the control panel is activated, which in turn opens the solenoid valve on the airline connected to the spray guns. The Airkem liquid is fed by gravity flow to the guns from a drum mounted inside the washer building. The Airkem liquid will not flow past the air guns when the air pressure is shut off.

A time lag of 30 seconds was incorporated into the design by use of a time relay; this is to prevent excessive activation of the unit due to sudden gusts of wind, or change in wind direction. The solenoid air valve can be operated manually by a switch in the control box, which is located on ground floor beneath the air valve.

Field studies and observation of local reactions indicated that the installation was a success. The Airkem odor control technique has been in operation for several years, giving the plant an economical and practical method of solving its odor and community relations problems.



Interior view of vane control box. Unit permits automatic or manual control of odor control equipment installed.

Meteorology and Air Pollution

by **Stephen Pisklak**
Project Engineer, Rett Products

Plant engineer measures wind speed with hand-held anemometer. By checking wind speed and direction, plant engineers can often save power costs, possibly eliminate or bypass collectors on some days.

How to use the weather to control air pollution, improve the operation of dust collecting equipment, improve local community relations, schedule collector repair.

Mechanical and electrical smoke retarders and collectors which industries use to abate air pollution are not, in themselves, the complete answer to the air pollution problem. It is impossible to eliminate industrial smoke and fumes completely. Even if efficiency of present effluent control systems were doubled, there would still exist meteorological conditions which would concentrate pollutants to a serious degree. Problem is further agitated by the growing number of industries in those areas that have poor climate for natural dispersion of stack wastes.

Many industries have decided not to fight the weather, but to join it in solving their air pollution problems. They find that the atmosphere offers three distinct advantages over other air pollution devices: 1) initial cost is nothing, 2) it is readily available and 3) its maintenance cost is nothing. Main disadvantage of using the atmosphere as a control device is its inability to disperse contaminants properly at all times. Key to solving the air pollution problem for many industries is to know when the atmosphere is behaving to their advantage.

By knowing when and how often the meteorological conditions of the atmosphere are proper to exhaust gaseous wastes directly to the atmosphere, a company can save the cost of power, scrubbing medium and material disposal of their collectors. Industries that can schedule auxiliary operations, for which continuous production is not required, may find that the atmosphere can be used exclusive of costly installations to solve their air pollution problem. A knowledge of the atmospheric conditions which cause industrial air-borne contaminants to collect in dangerous amounts could guide the plant manager in the discretionary use of his control equipment.

Theory of meteorological air pollution control is really not complex. A meteorological term which is closely associated with the problem of air pollution is "atmospheric stability." Temperature usually varies with altitude in any vicinity. The standard or normal variance is a decrease in temperature of about 1 C for every 100 meters increase in altitude. A temperature decrease less than this "lapse rate" indicates a stable atmosphere, whereas a temperature decrease greater than 1 C per 100 meters indicates an unstable atmosphere. If the temperature of the lower layers of the atmosphere increases with altitude rather than decreases, the condition is known as "inversion," and no change in temperature with increasing altitude, is called an isothermal layer of atmosphere.

Stable Atmosphere Blankets Pollution

Significance of a stable atmosphere lies in the fact that under this condition, forces on any mass of air are virtually in a state of equilibrium. This can be explained from the fact that as a mass of air rises, atmospheric pressure on the mass is reduced, which causes the mass of air to expand. But as a gas expands, its temperature decreases (assuming no heat is transferred by the surrounding medium). If, after reaching a certain height, the temperature of the surrounding atmosphere is greater than the temperature of the rising mass of air (which will be the case in a stable atmosphere) heat transfer will cause the rising air mass to compress, thus become denser, and force air in the direction of its original position. If, on the other hand, a mass of air under stable atmospheric conditions tried to move downward, it would necessarily be compressed by the atmosphere and tend to gain in temperature. But the surrounding

atmosphere would be at a lower temperature than this air mass and, by heat transfer, tend to expand the mass of air and hold it at its original level.

Because of inability of air to move vertically in a stable atmosphere, stack effluent will remain at or near level of discharge and will meet with resistance to upward or downward dispersion. A wind speed slow enough to hold the smoke near lamina flow, together with a wind drift in the wrong direction can mean the wrath of a community. This condition is sometimes coupled with a high relative humidity, in which case particles of the effluent act as "condensation nuclei" and a smog condition will exist.

Using Weather To Disperse Pollutants

There are two general ways in which the atmosphere disperses contaminants; transport by the winds and turbulent diffusion. The wind direction will, at any given time, determine area into which stack gases or cloud of particles will move and wind speed will determine how rapidly they will advance to that area. Because of turbulence of flow, concentration at a point downwind from a stack will be generally inversely proportional to wind speed. Turbulent diffusion is caused by natural turbulence of wind which disperses particles. Fluctuations of wind speed and direction are indications of turbulence.

By employing a wind indicating system which gives a permanent continuous record of wind direction and speed, a plant manager could determine the combination of wind direction and speed which will permit him to discharge his flue gases directly to the atmosphere or reduce load on his collectors. This could be done by comparing wind velocity at stack site with samples of the atmosphere taken from various areas around the plant. Those combinations of wind speed and direction which show unfavorable results would be noted and full load on the collectors or a reduction of operations would be maintained while the condition exists. Permanent record of wind velocity at any given time, studied together with complaints of air pollution from a community, could establish legal evidence that a plant was not the cause of air pollution; or, if it was, permit the plant manager to avoid that situation in the future.

Indicating Instruments

The wind indicating systems used today are rugged, time proven instruments which have been favorably accepted by the armed forces for their meteorological stations all over the world. They all perform under the same basic operating principle. The wind hits a curved surface fixed upon a shaft, causing it to rotate with a speed proportional to wind speed. This rotational speed is indicated by a tachometer calibrated to read wind speed in knots or miles per hour. Wind direction is determined by amount of rotation of a vane from a fixed position. This rotation could either be read directly or remotely by mechanical or electrical means.

One versatile, widely used wind indicating system consists of a wind detector and an indicator. The detector is mounted near the stack exhaust free from any wind obstruction. It consists of a rotating impeller type anemometer and a vane which points the rotor into the wind stream. The rotor is coupled to a small d-c generator which in turn is electrically connected to a voltmeter housed in the indicator. As the vane turns with the wind direction, amount of its rotation from a fixed north position is shown on dial of the indicator. This is accomplished by means

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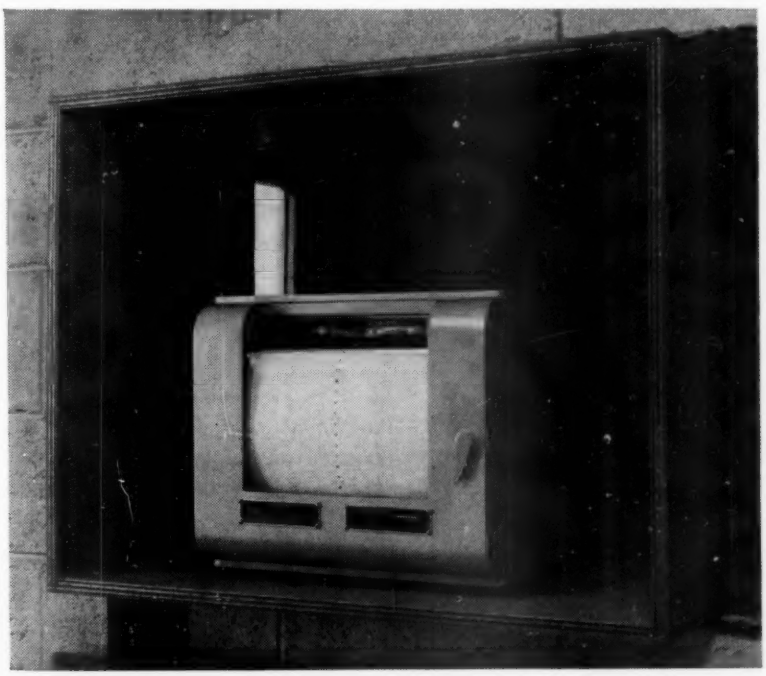

Wind recorder makes permanent record of wind direction and speed. Such a record is helpful not only in establishing localized knowledge of weather conditions that may permit plant engineer to discharge collectors directly to atmosphere, but can form basis of records to prove his plant is not causing air pollution.

(Continued from preceding page)

of two self-synchronous motors, or synchros, one in the detector and one in the indicator. The rotation of one synchro will cause the other, electrically connected to it, to rotate the same amount.

In addition to direct visual indications of wind speed and direction, indicators are available which give permanent records of wind direction and speed at any instant. Indications of "gustiness" or rate at which direction and speed of winds change can be readily obtained with such an instrument. These recording instruments consist of pens attached to pointers of receiving elements, and a chart drive mechanism which moves graph paper across the recording pens at a constant rate. The paper is calibrated in two scales, one for the speed recording pen and one for the direction recording pen. A set of variable speed gears varies the graph paper speed depending on the time interval per inch of graph paper desired.

Wind Indicators

Wind direction and speed sensing instruments which operate from a 115 volt a-c supply are commercially available in ranges of 0 to as much as 280 mph, with accuracies of plus and minus 1 percent throughout the range. The wind direction portion of these systems are accurate to within 4° of true wind direction. For plant site surveys for which the prevailing wind direction and speed is a factor, inexpensive hand held sensing devices are also available. These units could be used by those plants where stacks are readily accessible for periodic checks of wind conditions if the size of the plant operations does not warrant the larger installation.

Wind direction and speed indicating unit for remote reading in the plant. Indicator detects wind speeds up to 120 knots/hour, reads on dials inside plant office through use of a dual-motor synchro system.

Use of Wind Sensing Instruments

There are many ways in which wind sensing instruments can aid industry. In addition to informing the plant manager of what the wind is doing to the stack gases, a wind indicating system could activate a relay which would in turn cut off or retard the load on the collectors when the combination of wind speed and direction were favorable. With his permanent record of wind speeds and fluctuations, and wind direction, the plant manager could forecast appropriate times during the day to save the use of his collectors and discharge his stack wastes directly into the atmosphere. In a congested industrial area where many plants contribute to the air pollution problems of a community, a permanent record proving that his exhaust was directed away from the area could provide evidence that the plant manager did not contribute to the problem. Scheduling of collection equipment shut-downs for repairs can be made for periods of good atmospheric diffusion of contaminants.

With the increasing population of this country comes the increasing demand for durable consumer goods. Industries are expanding their facilities to meet this demand. As their facilities increase, so will the air-borne contaminants that plague our communities. To agitate matters, communities are growing larger and more congested, despite the migration to the suburban areas. Their automobiles, house furnaces and incinerators do not aid the problem. The problem of air pollution will consequently increase to disastrous proportions unless positive steps such as those outlined are taken by industry today.

Comments on Air Pollution

Air pollution has been plaguing man ever since he coughed from the smoke of a forest fire or sneezed in a ragweed pollen breeze. His problem was intensified by use of coal as a fuel. The thick carbon-laden smoke which characterized the inefficient burners of yesteryear made the smoke problem in England so acute that Queen Elizabeth I forbade coal to be burned while Parliament was in session.

Today, 350 years later, we still find air pollution among the most serious problems facing the nation. Thousands of deaths annually are attributed to air-borne contaminants of trace sulfuric and sulfurous acid, carbon compounds, fluorides, sulfates, arsenic and other toxic materials. Bacteria and virus spread is greater in industrialized areas, giving rise to belief that particles of industrial waste in air contribute to this spread. The public feels industry should shoulder responsibility for air pollution since it is to blame for it.

How Dow Burns Wastes ... To Make Friends

by Charles Sercu
Superintendent of Incineration
Waste Control and Utilization Dept.
Midland Division, Dow Chemical Co.

From chemical plants come a complex group of wastes, along with a headache disposal problem. How Dow burns wide variety of wastes without smoke, odor fumes or hazard makes interesting reading for waste control engineers everywhere. This is the first of a series on the Dow solution to waste problems. Next month, details of equipment.

Incineration facilities capable of destroying 81 million Btu per hour of liquid tars and 60 million Btu per hour of solid refuse have recently been completed at the Midland, Mich. plant of The Dow Chemical Company. Storage, mixing and blending facilities for both liquid and solid wastes are included as are scrubbing facilities for fly ash and acid gases. This two million dollar installation allows handling and burning of large tonnages of wastes with a minimum of air pollution and a maximum of safety.

The Midland plant generates approximately 100,000 gallons per week of liquid still residues, washes, slurries and contaminated liquid products that must be destroyed. Over 1,700 drums and similar containers of semi-liquid and solid waste chemicals are produced monthly, in addition to almost 17,000 cu. yds. per month of other refuse.

Many Types of Refuse

Refuse at Dow consists of plastics, paper, boxes and other solids of high Btu content, plus many non-burnable solids. Most of the waste products from laboratories are extremely hazardous. Toxic, reactive or explosive, these items are frequently the toughest disposal problems.

Safe and efficient disposal of all of these materials is now accomplished by control of the collection, handling, and incineration of the wastes. Collection and handling are determined by volume, character and hazards involved in the material. Control of the incineration of these wastes is accomplished by blending, mixing or burning the material separately in a well designed incinerator.

Fig. 1: *Waste holding tanks and dumping areas. Tanks are 10 ft. in diameter, 12-15 high, have turbine agitators.*

Fig. 2: *Truck is dumping load of waste into holding tank. 700 gal. tar can be dumped in under 3 minutes. Light beam, broken when truck backs in, sounds alarm to alert nearby personnel in case of spillage or accident.*

Waste Handling Problems

Solid tars from the production plants at Midland originally were buried, and, as the plant expanded, many of these wastes had to be rehandled and moved again. To eliminate this problem, the tars were hauled from production to a hand-stoked vertical tar incinerator. A rotary kiln was installed in 1948 with an ash recycle system to aid in burning these hard tars. It soon became obvious that the rotary furnace could burn a tremendous amount of solid refuse, paper, boxes, drums of chemicals, with a minimum of effort. The ash recycle was giving problems, and was abandoned, as it had been proved that the tars could be hauled in liquid form and pumped to the incinerator more efficiently than being handled as a solid.

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The Dow Midland plant was expanding at a rapid rate and there were a lot of construction materials to dispose of at this time. Gradually, the original 10 ft. diameter by 25 ft. long kiln became overloaded and much refuse had to be burned on an open dump.

The kiln was not equipped with secondary combustion or air control and all feeding was done by hand, so most of the time a plume of black smoke poured from the stack. All refuse was introduced to the kiln through a 4 ft. diameter open hole in the floor. This is actually the simplest and most economical way to feed a kiln as the operator can view the fire at all times. Ignoring air pollution and safety considerations, this is an expedient way to get rid of just about any type of combustible waste.

The Air Pollution Control and Safety Departments at Dow were very much troubled over this operation, but there was no safer incineration process available. Landfill of the solid wastes had been attempted, but this was costly, gave the opportunity for ground water contamination and the danger of fire in the fill area was always present.

Plastic Refuse Sticky Problem

Most types of furnaces could not satisfactorily burn plastics. The wastes from the polystyrene plant melt and burn at the same time. It was visualized how this viscous material would then drop through grates and harden upon cooling, plugging the grates and building up on hearths. In the rotary kiln, the melting plastic mingles with the ash or sticks to the sides of the kiln and burns completely. This was observed in the existing rotary kiln incinerator, but tremendous quantities of black smoke were also observed, belching from the stack. Having determined the amount and character of the material to be burned, an investigation was initiated to determine cost and basic design of an incinerator that would satisfy all requirements.

A literature study produced the Volund patent on a rotary kiln incinerator, which patent rights are held by the International Incinerator Company of Atlanta, Georgia. Further investigation of the municipal rotary kiln type incinerator in Atlanta, Georgia indicated that this type of unit could satisfactorily and continuously burn garbage and refuse with a minimum of smoke and odor.

The incineration problem at Dow Midland is quite different from a normal municipal situation. Chemical wastes, plastics, still residues and even plant rubbish have a much higher Btu content that ordinary garbage and refuse. The hydrocarbon nature of most of the wastes produces a very dense black smoke and occasionally a drum or can of chemicals will explode in the fire.

Cognizant of the complexity of the problem, and with the cooperation of Dow engineers, International Incinerators, Inc., Atlanta, agreed to design a rotary kiln incinerator for this unusual application.

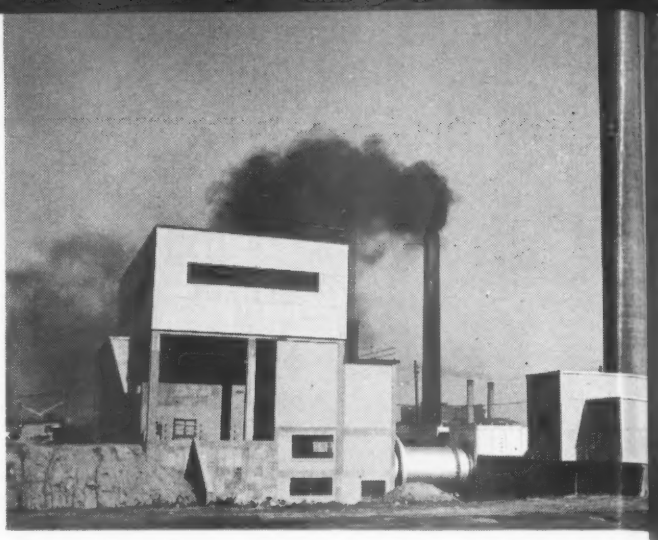


Fig. 3: *New incinerator, foreground, burns without smoke plume or odor. In background, old incinerator, soon to be scrapped, burns with heavy plume of black smoke. New, modern incineration facilities at Dow, to be described in detail in May issue as second part of this article, handle wide variety of burnable wastes from plastics to heavy tars, paper to solvents. Installed is a specially designed rotary kiln patterned after municipal disposal plants.*

Placed in operation in January, 1959, the unit operates satisfactorily and does destroy all of the Dow Midland solid combustible wastes and many of the liquid wastes without smoke or odor problems. A stationary tar furnace complete with off-gas scrubbing facilities was placed in operation in the spring of 1958 and has noticeably reduced the odors in the Midland area caused by the burning of combustible liquid wastes.

Liquid Wastes Vary

These liquid wastes called "tars" are by-products, contaminated chemicals or bad batches that cannot be reclaimed economically or for which there is no market. The materials vary from light solvents to very heavy still residues. Some of these residues and slurries are very high in water content as they have been removed from waste water streams emanating from production processes. These materials cannot be satisfactorily treated in the biological treatment process of the Dow liquid waste treatment plant, and must be destroyed by incineration.

All waste tars are hauled to the incinerator area in Dempster Dumpster tanks. The trucks drive up a ramp and dump into the top of agitated holding tanks. Large hoppers are provided on top of the tanks to prevent spillage during the rapid dumping process which normally takes two to three minutes to transfer 700 gallons of tar. Bar screens in the bottom of the hoppers collect debris, gravel or large solids that may happen to be present in the Dempster tanks.

Second in this series of articles will appear in the May issue of AIR ENGINEERING.

News of the Industry

(Continued from page 19)

Commerce Oil Refining Corp. planned to appeal the ruling of a Federal court judge who permanently restrained the firm from building a $55,000,000 refinery at Jamestown, R. I. The refinery would constitute a nuisance because of noxious gases and odors which would lower nearby property values, the judge decided.

* * *

The Army Chemical Corps has come up with two new defense "weapons" which may find important uses in civilian industries.

One is an electronic device, called the "aeroscloscope," which counts microscopic airborne germs, dust, and moisture particles at the rate of 100 a second. The other—the so-called Andersen sampler—not only detects minute particles in the air but also separates them according to size and identifies them.

The aeroscloscope was developed to serve primarily as a defense weapon against germ warfare. However, its greatest use may be in flour mills, paint factories, cosmetic firms, and other industries where control of particle size or detection of airborne contaminants is of vital concern. The instrument, in present form, measures particles from one micron to 64 microns and can be modified to detect even tinier particles.

How Device Works

Principle of the device is based on the phenomenon that the dust particles seen in a shaft of light actually are only reflections of the particles themselves. As air-carried particles in concentrations up to 15,000 per milliliter travel through the instrument, they are diluted, and their flow rate controlled so that each is individually illuminated. A photomultiplier tube detects the reflection caused by the illumination. The tube, in conjunction with other devices, can determine the size of each particle.

The Andersen sampler, believes its inventor, Dr. Ariel A. Andersen, will find its most important application—aside from military use—in detecting disease-producing organisms in the air of hospitals and schools. Key point here is the knowledge that the potency of a pathogenic air mass depends on the size and number of the particles per unit volume of air.

Some insects are living thermometers, says the National Geographic Society, and an observer can read from their actions the temperature in degrees Fahrenheit. One example cited: The snowy tree cricket. The tempo of its "serenade" is determined by the temperature; the warmer it is, the faster the cricket chirps.

* * *

Extracts from 53rd annual report of the non-profit Air Pollution Control League of Greater Cincinnati:

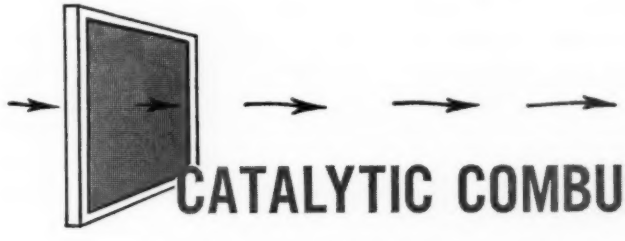
"Most of the things which are now accepted as being responsible for community air pollution will get worse in the near future. By 1970 the nation's population will increase by 25 percent. . . . Our industrial output will double. . . .

"Air pollution is not primarily, or solely, a problem of industry. It is the problem of the activities of the entire community. . . .

"In air pollution control whatever is good enough today will not be good enough tomorrow. As the population grows the problem will increase both in intensity and complexity. . . .

"The objective of air pollution control legislation should be to recognize the right to the use of the air and the responsibility to avoid its abuse.

"Air pollution and its control involve many scientific problems that have not yet been solved. . . . Continued research in this field is vitally necessary. . . ."



CATALYTIC COMBUSTION

- Reduces high operating costs
- Solves condensate problems
- Eliminates air pollution

CATALYTIC'S SIMPLE, PATENTED, "ALL-METAL" CATALYST IS THE KEY THAT TURNS EXHAUST FUMES INTO ODORLESS HEAT . . . READY TO USE

Over 800 wire-enameling ovens, equipped with Catalytic Systems, no longer need be shut down for cleaning hazardous condensates. In addition to this saving of down time and operating costs, users tell us more uniform coatings result from ovens equipped in this manner.

More than 400 other ovens and furnaces are equipped with Catalytic Systems, supplied directly to the customer or through the oven builder. Many of these installations include provision for heat recovery. Ovens used for paint baking, paper and fabric impregnating, coating, lithographing, curing, drying, and many other processes comprise the list of Catalytic Systems in operation.

Air-pollution-control officers and insurance underwriters are constantly approving the safe, efficient performance of Catalytic installations.

Your inquiry will receive our prompt and confidential attention. Write us today!

U. S. AND FOREIGN PATENTS GRANTED AND PENDING

Catalytic Combustion CORPORATION

CATALYSTS • FUME ELIMINATION AND HEAT RECOVERY SYSTEMS

4722 Fourteenth St., Detroit 8, Michigan

New Appointments

J. T. Conlon was elected president and chief executive officer of Gustin-Bacon Mfg. Co., Kansas City, Mo. He succeeds J. D. Simmons who continues as director and consultant.

Appointment of three new representatives in Tennessee and Georgia is announced by Jenn-Air Products Co., Inc., Indianapolis. O. M. Jones Co. of Johnson City, Tenn. will cover eastern part of the state, R. E. Gardner Co. of Nashville will cover central part of Tennessee, and Walter C. Strickland Co. of Atlanta will cover all Georgia.

Appointment of Emil Peslar as vice president of operations with responsibility over both the Decatur, Ill. and Grantley (York, Pa.) Works has been announced by Henry M. Haase, president of York Div., Borg-Warner Corp.

Previously vice president and general manager of the Grantley Works, Peslar assumed responsibility for the Decatur plant on the retirement of S. S. Meadows as vice president and general manager there.

Peslar had been vice president and plant manager of the Marvel-Schelber Products Div. of Borg-Warner at Decatur.

Richard H. Schlebohm has been appointed manager of the new Philadelphia district office of the Industrial Div. of Joy Mfg. Co.

The new office, at 1420 Walnut St. will cover portions of Pennsylvania, New Jersey, Maryland, Delaware, Virginia, West Virginia, and the District of Columbia.

Ford Stoddard, president of Stoddard Industries, Chicago, announced in February that he had assumed the duties of general manager in the company's Chicago office.

Robert M. Stoddard, who formerly directed the manufacture and sales of Dust-magnet filters, now devotes his full time to administrative and manufacturing duties at the Stoddard-Quirk Mfg. Co. factory in Clarendon, Ark.

All sales activities of Stoddard Industries are now handled by Ford Stoddard and his assistant, Gene O'Sullivan.

Election of John T. Doyle as president and chief executive officer and Louis C. Whiton as chairman of the board is announced by the Thermix Corp., Greenwich, Conn., project engineering firm.

Doyle, executive vice president since 1952, is a former director of the Air Pollution Control Association.

Whiton, a member of the board since 1946, is also chairman of the board of Prat-Daniel Corp., which he founded in 1921. Prat-Daniel is a Thermix affiliate.

Aerosol Deodorizer

Aireactor space deodorizer, an odor counteractant and air freshener, has been formulated into an aerosol and put on the market as Aireactor Mist by Aireactor Corp.

Aireactor Mist is composed of non-toxic odor destroying elements of rare plant life, glycols to combat air borne bacteria, and new SX-5 to precipitate smoke, all compressed into a 12 oz. container.

This deodorizer is also incorporated in the detergent germicide made by Aireactor under the name Aireactor DDG.

Source: *Aireactor Corp., Dept. AE, 271 Madison Ave., New York 16, N. Y.*

THE Staplex
HI-VOLUME AIR SAMPLER
for your most exacting requirements

FOR INDOOR OR OUTDOOR SAMPLING

Accurately samples to 1/100 of a micron . . indispensable for series or unit sampling . . portable . . plugs in to any 110 Volt outlet.

Used to measure air pollutants such as radioactive material, chemical dusts, smoke and smog, and in geodetic surveys, missiles research, mining, factory safety programs, plant and insurance inspections, etc.

Write for new brochure

THE Staplex CO.
AIR SAMPLER DIVISION

777 FIFTH AVENUE
BROOKLYN 32, N.Y.
Dept. AE

Use Communications Center, page 65, for requesting more information about articles, advertised products, literature, etc.

New Literature

Sound Control Bulletin

Four-page bulletin IT-59 describes Lo-Stat and standard sound traps; interwall sound barriers, and nationwide acoustical services of Insul-Coustic Corp. Contains illustrations of several recently completed buildings employing I-C mechanical and architectural products and sound attenuation systems.

Source: *Insul-Coustic Corp., Dept. AE, 42-23 54th Road, Maspeth 78, N. Y.*

Test Sets for Engineers

A four-page catalog of airflow instruments test sets for test engineers is released by the Thermix Corp. It also covers pitot-static tubes.

Source: *The Thermix Corp., Dept. AE, Greenwich, Conn.*

Turn to Typhoon

Reasons why plant managers should do this for greater profits through greater production are outlined in an eight-page brochure published by Typhoon Air Conditioning Co.

The booklet lists reasons for air conditioning, improvement in employe efficiency, company background, and purchase or lease terms.

Source: *Typhoon Air Conditioning Co., Div. of Hupp Corp., Dept. AE, Brooklyn 15, N. Y.*

Felts for Filtration

Technical Data Sheet No. 15 covering performance characteristics and selection of proper felts for mechanical filtration of air, gases, and liquids is announced by the American Felt Co.

It lists revisions on porosity percentage figures for felt weights and includes data on merchandise not listed in the original 1946 issue.

Source: *American Felt Co., Dept. AE, Glenville, Conn.*

V-Belt Pulley Catalog

Specifications on standard sizes of single groove V-belt pulleys are spelled out in a circular recently issued by Nagel-Chase Mfg. Co.

The pulleys are designed for use by manufacturers of fractional horsepower equipment.

Source: *Nagel-Chase Mfg. Co., Dept. AE, 2811 N. Ashland Ave., Chicago 13, Ill.*

Waterloo Fast-Selection Catalog

Easy and accurate selection of all types of air diffusion equipment is possible with new Waterloo Register Co. catalog. It includes data on entire Waterloo line, including removable core grilles with separate frames introduced this year.

Four major product groups are color keyed for quick identification. Titles in section on wall and ceiling type supply grilles and registers are in red. For wall, ceiling, and door type return grilles and registers, color is green.

Blue titles cover extruded aluminum airline grilles. Brown refers to accessories and miscellaneous products.

Each section includes detailed selection tables and illustrations.

Source: *Waterloo Register Co., Inc., Dept. AE, P. O. Box 72, Waterloo, Iowa.*

Process Instruments Catalog

Fischer & Porter has published a 52-page catalog on process instruments including indicators, transmitters, recorders, and controllers for flow, pressure, temperature, density, viscosity, and consistency.

Instruments covered in Catalog 2 are available for quick shipment and standard instruments are stocked at five warehouses across the U. S. and Canada.

Source: *Fischer & Porter Co., Dept. AE, 941 Jacksonville Rd., Hatboro, Pa.*

EASTONAIR IS THE BEST MADE, BEST KNOWN, BEST ACTING, BEST BY FAR

EASTONAIR
ODOR/FUME
CONTROLLANT

THE PROFESSIONAL ODOR/FUME CONTROLLANT . . . A SOLID AVAILABLE IN THREE SIZES THAT FIT ANY TONNAGE OR MAKE OF AIR HANDLING SYSTEM . . . UNITS ARE PROFESSIONALLY ENGINEERED FOR AIR HANDLING EQUIPMENT . . . NEEDS NO TIMERS, SPRAYERS, OR EXPENSIVE DISPENSING UNITS . . . IS NOT TO BE CONFUSED WITH NEUTRALANTS OR COUNTERACTANTS SOLD BY SUPERMARKETS . . . DEVELOPED FOR PROFESSIONAL INSTALLATIONS . . . EASTONAIR GIVES ODORLESS RESULTS . . . NO ODOR, NO PERFUME, NO FRAGRANCE OR SMELL . . . BUT YOU DO GET

Cleaner, Fresher Air

LISTED IN AIR CONDITIONING PUBLICATIONS, DIRECTORIES AND CATALOGUES . . . AVAILABLE THROUGH ALL LEADING JOBBERS AND DEALERS . . . RECOMMENDED, SOLD, INSTALLED BY LEADING AIR ENGINEERS EVERYWHERE

EASTONAIR
IS GUARANTEED

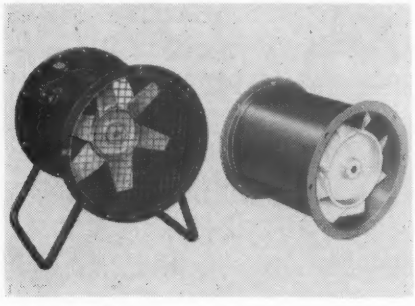
THE ONLY ODOR/FUME CONTROLLANT ACCEPTED BY THE TEXTILE INDUSTRY TO CONTROL FORMALDEHYDE FUMES IN AIR CONDITIONED STORES . . . BACKED UP IN EVERY WAY BY AN ABSOLUTELY UNQUALIFIED COMPLETE GUARANTEE!

EASTON R.S. CORP
876 PACIFIC STREET
BROOKLYN 38, N. Y.

(Continued from page 10)

Pressure Type Industrial Fan

New line of pressure type tubeaxial fans to handle air, fumes, light dusts in industrial applications has been developed by Propellair.



Type DT fans are equipped with matched design motors and propellers made by same manufacturer. Propeller diameters are 8, 12, 16, 20, 24 in. with sizes through 60 in. under development. Capacities range from 200 to 1200 cfm from free air to 5 in. s.p. Propellers are of magnesium-aluminum alloy and of airfoil design.

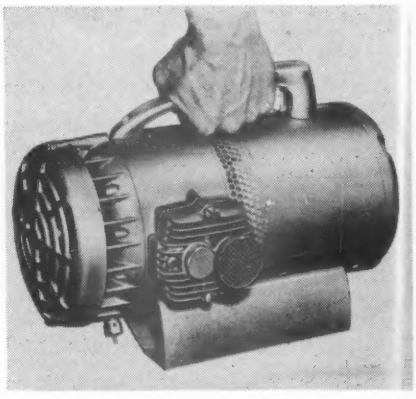
Totally enclosed motors equipped with sealed, prelubricated cartridge bearings for mounting in any position. Single phase or polyphase motors available in all standard voltages; high temperature Class B and explosion proof motors also available.

Fan bodies are tubeaxial drums of heavy gauge rolled steel. Sizes above 8 in. equipped with mounting flanges.

Source: *Propellair Div., Robbins & Myers, Inc., Dept. AE, Springfield, Ohio.*

Air Sampling Vacuum Pump

Low cost air pump designed as continuous duty vacuum source for use in air pollution studies is offered by Gelman Instrument Co. Activated by graphite ringed pistons, it gives volumetric flow over wide range of vacuum conditions.



Choice of air capacity is 2 or 4 cfm. All bearings are grease packed and sealed. Inlet and exhaust valves are optically polished to give leakproof fit. Piston ring joints are self-sealing.

For air pollution work, pump is available in weatherproof shelter.

Source: *Gelman Instrument Co., Dept. AE, 233 Jefferson St., Chelsea, Mich.*

Penthouse Louverdomes

Penthouse Louverdomes designed for on-roof installations requiring both overhead lighting and ventilation.

Factory assembled, they consist of Vanco Domelites set on extruded aluminum louvered penthouses. Domelites are made of shatterproof, weather-resistant, one-piece acrylic plexiglas. Penthouses provide four-sided ventilation.

Penthouse Louverdomes are available either square or rectangular of any height in 4 in. increments.

Source: *E. Van Noorden Co., Dept. AE, 118 Magazine St., Boston 19, Mass.*

(Please turn to following page)

Use Communications Center, page 65, for requesting more information about articles, advertised products, literature, and for comments about any of the editorial material in this issue of AIR ENGINEERING.

salvage
valuable dust
at lower cost with
up to 99.8% efficiency

With DUSTEX dry-type collection you can obtain virtually total recovery of airborne dusts without maintenance of the miniature cyclones . . . and with impressive savings in installed cost and space requirements.

Rugged all-metal construction with no moving parts, no filters to clog, no sludge to pump. Perfected DUSTEX tubes of cast white iron alloy are self-cleaning and are designed to assure maximum material recovery and highest operating efficiency.

If you are manufacturing or processing agricultural chemicals, check the advantages of the high-efficiency DUSTEX Model D-584. Drop us a line today.

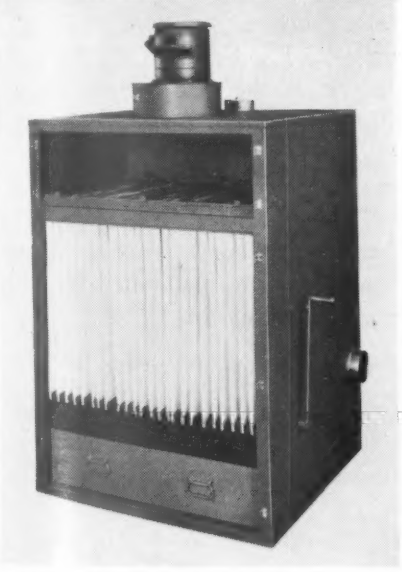
P.O. BOX 2520, BUFFALO 25, N.Y.
DUSTEX CORP.

(Continued from preceding page)

Cloth Filter Dust Collector

New cabinet cloth filter type dust collector operating in 650-1,535 cfm range has nearly 100 percent dust filtering efficiency, according to Torit Mfg. Co.

Model 90 collects more than 99.9 percent by weight even with high concentration of particles smaller than 1 micron, company says. Dust is trapped on under, outer sides of fire resistant filter bags eliminating fan loading or damage, as blower is on clean air side.



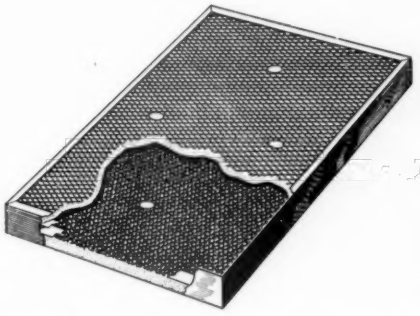
Most dust settles into drawer or hopper base. Clinging dust is dislodged by filter shaker outside cabinet. Drawer has 5.5 cu. ft. capacity, hopper base 9 cu. ft. Total cloth filtering area is 250 sq. ft.

Source: *Torit Mfg. Co., Dept. AE, Walnut & Exchange Sts., St. Paul, Minn.*

3-Stage Grease Filter

New three-stage, double flame baffle grease filter that practically eliminates cause of flame flash through filter into ductwork is introduced by Extraer Inc.

Double flame baffle has two filter units in single steel frame separated by $\frac{5}{8}$ in. air space which acts as cooling and solidifying chamber.



Elektra grease filter is made to fit all standard and non-standard grease canopy hoods.

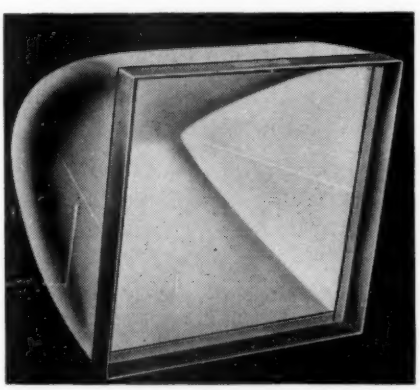
Source: *Extraer Inc., Dept. AE, 1210 Chenevert, Houston, Texas.*

Parabolic Bag Type Filter

Parabolic shaped disposable bag type filter for air conditioning, heating, and ventilating systems.

Company claims filtering action is strongest where dust particles are finest, air flow is strongest where accumulation of large dust particles is greatest. Least resistance is at back of bag, gradually increasing up sides.

Company also claims for Pure-Air B/T filter large dirt holding capacity, .1 in. water gauge resistance at 350 fpm, and more than double the life of conventional throwaway filters.



Mouth of filter has stiff fiber frame facilitating insertion and removal. It fits most filter banks with downstream clearance of 18 in. Standard sizes priced from $1.80 to $2.50.

Source: *Arco Mfg. Corp., Dept. AE, 542 W. 55th St., New York 19.*

(Please turn to page 79)

Dwyer
CONTROLS GAGES

AIR VELOCITY METER
No. 400

One Instrument Tells Both Air Velocity and Static Pressure!

- Reads directly in feet per minute and inches of water.
- Check *all* velocities from 400 to 10,000 F.P.M.
- All static pressures from 0 to 10" of water.

Tests fan and blower discharge and inlet pressures, pressure drop across filters, balances air conditioning systems, etc. Complete kit includes dual purpose manometer, 18" stainless steel pitot tube, Magnetic mounting panel and all necessary fittings, tubings, instructions and accessories.

Write today for literature and prices.

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P.O. Box 373-A Michigan City, Ind.

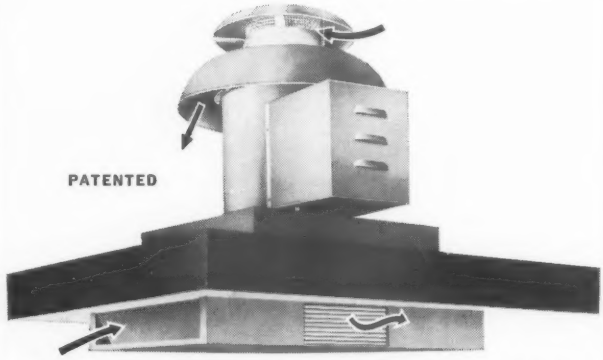
A simple, direct reading on the Alnor Velometer gives you an instant measure of air flow speed through grilles, ducts, furnaces, spray booths, or in the open.

Precision-built and self-contained, this portable instrument brings laboratory standards to the line or field installation. Available in a wide variety of scale ranges, full assortment of jets and fittings. You'll want all the facts (no safety department should be without a Velometer). Get Bulletin 2448-G. Attach this ad to your letterhead and mail to: Illinois Testing Laboratories, Inc., Room 570, 420 No. LaSalle St., Chicago 10, Illinois.

PRECISION INSTRUMENTS
FOR EVERY INDUSTRY

Alnor

A NEW, UNIQUE, EXHAUST AND SUPPLY VENTILATOR!



The DUAL-AIRE VENTILATOR

Exhausts and supplies air at the same time in a single installation. Forces fresh air down through a center duct while exhausting stale air up through an outer concentric duct. One roof opening and one motor do double duty. The supply-exhaust ratio may be set at manufacture. The motor is equipped with a variable-speed pulley for simple adjustment of air volumes. The unit will not cause undue negative pressure which may result from exhaust ventilators alone.

Manufactured by Canada Fans Limited. Available now.

For technical information or demonstration, contact:

J. K. BRASCH, Representative
301 POTTER STREET • ANN ARBOR, MICHIGAN

Hospital Air Sanitation

(Continued from page 26)

lithium chloride solution, air is maintained at lowest population of airborne micro-organisms yet found practical.

2. Elimination of all contaminating exposed water in ventilating and air conditioning system.

3. More accurate control of necessary humidity in rooms where anesthetic gases are used in order to prevent explosion caused by static electricity generation at low levels of relative humidity.

Building With a Brain

(Continued from page 23)

modulates the maximum fresh air damper (D 21), recirculating air damper (D 22) and exhaust damper (D 23) to maintain the desired mixed air temperature. Fifty percent fresh air is design condition. Whenever outdoor air rises above 75 F a thermostat (T 13) at the outdoor air inlet closes the maximum fresh air damper and repositions dampers D 21, D 22, and D 23 to pass only 25 percent fresh air.

A gradual air switch, operated from the console positions the control point of a thermostat (T 16) downstream from the hot deck coil. This modulates the heating coil valve (V 12) to maintain scheduled hot deck temperature (designed for 110 F).

Freeze Protection

A freeze protection thermostat (T 15) down stream from the cooling coil stops the fan whenever the cooling coil discharge temperature falls below its setting.

A variable vortex damper on each fan system, manually controlled, cuts down on air volume for winter operation and increases it for summer cycle.

Vaults A Special Problem

A special problem was air conditioning the sub-basement trust vault. A low velocity, single duct system is used. To avoid penetrating the 2 ft. thick wall that surrounds the trust vault, safety deposit vault, and trunk storage area, a distribution duct was brought to a plenum chamber built outside the security wall.

Access to the plenum room is possible only after passing several guards. A 7 ft. high, 1 ft. thick stainless steel door separates the plenum chamber from the trust vault. This door is manually opened in the morning and closed and locked at night.

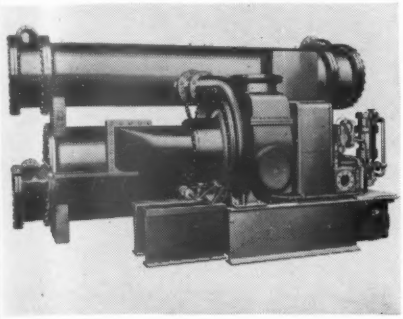
On the vault side of the door is a ceiling suspended ventilation unit that distributes air through distribution boxes above the ceiling pan. Ventilation rate is stepped up to 2.3 cfm per sq. ft. to reduce chemical vitiation of the atmosphere. This compares with a rate of about 1 cfm per sq. ft. in the rest of the building.

New PRODUCTS

(Continued from page 77)

Steam Driven Centravac

Steam driven turbine CenTraVac in 200 to 600 ton capacities is announced by the Trane Co. for comfort or process applications.



It is single stage centrifugal water chiller employing integral shaft design. Compressor impeller is mounted on turbine shaft and supported by turbine bearings. One piece compressor and steam driver are assembled on common baseplate.

Power is supplied by multi-stage turbine selected with steam conditions of 125 psi inlet 0° superheat, and 26-in. vacuum exhaust as standard. Turbines also available for other steam conditions.

Compressor operates at 6,500 rpm for 200 ton unit down to 3,600 rpm for units 1,000 tons and larger.

Other features are similar or same as in hermetic CenTraVac. Basic difference is that turbine CenTraVac requires shaft seal, similar to that used in Trane reciprocating compressor.

Control center of unit is instrument panel for remote location. It permits combination of speed and prerotation vane position to give best steam consumption from full load to 10 percent load.

Source: *The Trane Co., Dept. AE, La Crosse, Wis.*

Thermopositer Aids Research

Thermopositer is a new instrument to collect samples of airborne micro-organisms and deposit them on a substrate.

American Air Instrument Co., Inc. says it improves accuracy, shortens time required for research studies of airborne micro-organisms.

Portable, light in weight, it can be operated by relatively unskilled personnel. It requires only electric power and coolant to operate.

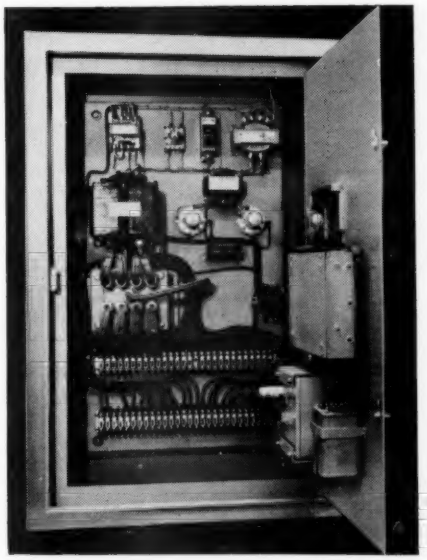
Source: *American Instrument Co., Inc., Dept. AE, 8030 Georgia Ave., Silver Spring, Md.*

Full Range Rapper Control

New full range Rapper Control System for Cottrell precipitators is offered by Western Precipitation Corp. It permits adjustability of rapping frequency, intensity, and pattern for removing materials collected on plates of electrical precipitators.

By adjusting a dial, rapping cycles can be varied from one every 50 seconds to one every 3½ hours. Rapping impact can be adjusted from zero to maximum. Two, four, or eight rappings per cycle may be selected and blows may be patterned from soft to heavy.

Full range unit is in low voltage category, timing circuitry is completely electronic. System requires only about half the space and volume of previous systems.



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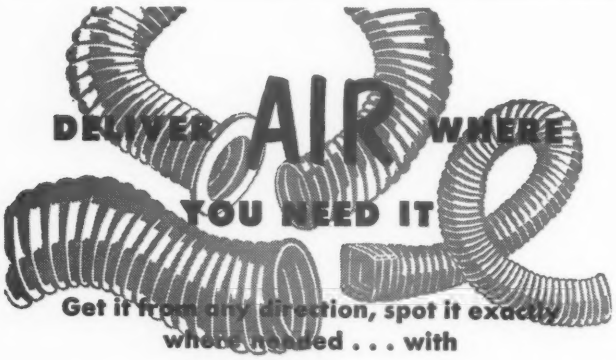

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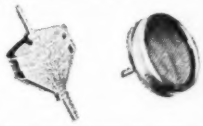

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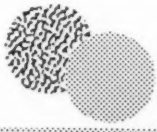

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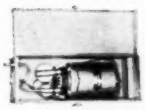

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Our investigations covering published material on air problems over the past two years brought us to the threshold of publication reality for AIR ENGINEERING with deep respect for the magnitude of the job. Our path is clear, our work is cut out for us, i.e., to serve engineer readers with the highest level of publishing performance we can muster.

Interest In AE Is Widespread

The enthusiastic reception given the announcement of AIR ENGINEERING has been most encouraging. Interest is widespread and emerges from deep in the heart of industry after industry. And thoughtful editorial material is prevalent, provocative. Thus, our problem of selection becomes acute.

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Air is the most vital tool of life. We can live for weeks without food, days without water, but only minutes without air. And this air should be clean air.

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Hundreds of orders came in before this first issue went to press. And as the word gets around, and our own subscription promotion moves out, we can look forward to early paid circulation audit for the benefit of advertisers.

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We think of our advertisers in this first issue with near reverence in their "pioneering" support and belief in our publishing efforts. In this regard, we hope you will let advertisers know you have read their advertisements in AIR ENGINEERING. This will be one way of lending support to this new publication.

And if you haven't done so already, please fill in one of the subscription order cards in this issue – you still have time to be a charter subscriber. Assure yourself that you will receive consecutive issues in the months ahead.

We invite your attention to page 65 where you'll find inquiry cards for requesting further information about articles, advertised products, literature, etc. Your using these cards helps everyone get in tune with AIR ENGINEERING.

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Let us hear from you.

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